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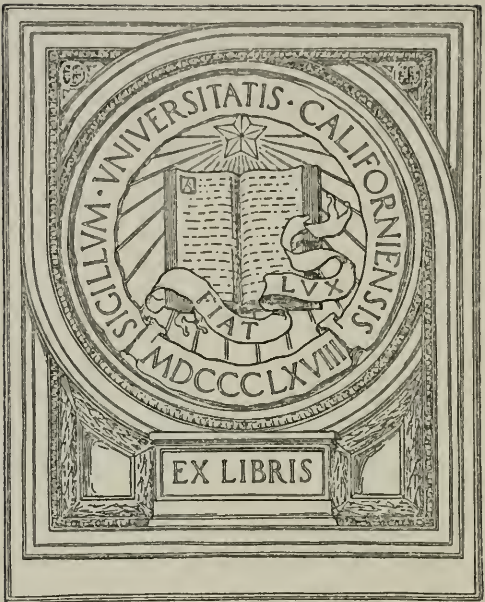
STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

GEOLOGIC DESCRIPTION
OF THE
MANGANESE DEPOSITS
OF CALIFORNIA

BULLETIN 152
Supplement to Bulletin 125

1950

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO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OLAF P. JENKINS, Chief

SAN FRANCISCO BULLETIN 152 APRIL 1950

GEOLOGIC DESCRIPTION OF THE MANGANESE DEPOSITS OF CALIFORNIA

By PARKER D. TRASK

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Presenting Results of a Cooperative Undertaking Between the United States Geological Survey and the California State Division of Mines

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LETTER OF TRANSMITTAL

To His Excellency
The Honorable Earl Warren
Governor of the State of California

Dear Sir:

I have the honor to transmit herewith Bulletin 152, *Geologic Description of the Manganese Deposits of California—Supplement to Bulletin 125*, prepared under the direction of Olaf P. Jenkins, Chief of the Division of Mines. This volume contains a series of detailed descriptions and maps of several hundred individual manganese deposits arranged alphabetically by the 44 counties which have contributed to the production of this strategic metal. Two world wars have been served by the manganese deposits of California, although in time of peace they have produced very little.

This report represents the results of a cooperative undertaking between the United States Geological Survey and California State Division of Mines. The principal author, Parker D. Trask, who was in charge of manganese investigations during World War II for the Federal Survey, together with 23 collaborating authors, has presented in this volume the detail which was omitted in the summary which appeared as the third chapter of Bulletin 125, issued by the Division of Mines in 1943. Bulletin 152 is, therefore, a supplement to the earlier Bulletin 125, and the method used in numbering and describing the properties is the same as that employed on *Economic Mineral Map of California, No. 5,* folded in the pocket of Bulletin 125.

The text of both bulletins as indicated in *Aids to Prospecting for Manganese* which appears in the *Introduction,* should serve as a guide and stimulus for further search for manganese. As a detailed record of all the state's known resources of manganese, this book should be of inestimable value should this nation again become involved in a war where foreign sources of supply are curtailed.

Respectfully submitted,

Warren T. Hannum, Director
Department of Natural Resources

April 29, 1949

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GEOLOGIC DESCRIPTION OF THE MANGANESE DEPOSITS OF CALIFORNIA

INTRODUCTION

By Parker D. Trask *

SCOPE OF REPORT

California contains many manganese deposits. During World War II the state was second in production in the United States, being exceeded only by Montana. At least 800 deposits from 675 localities in 44 counties are known. Production to the end of 1946 has been more than 168,000 tons valued at over $5,000,000. The maximum annual production was 30,000 tons in 1944.

Manganese mining in California is particularly attractive to the individual miner and to the small operator, for if price and specifications are favorable and if stock piles where small amounts of ore can be delivered are close to his property, he can produce material quantities of manganese with relatively little capital, provided he knows where to look.

The mining of manganese in California, however, is essentially a wartime operation. More than 80 percent of the past production has been during the two war periods: 70,000 tons between 1915 and 1919 and 79,000 tons between 1941 and 1945. In an average year during peace time, only a few hundred tons are produced, and in some years, notably 1946, no manganese ore was marketed at all. Factors contributing to the small production during times of peace are the generally small size of the deposits and the low grade and high silica content of the ore. Most of the known ore bodies contain less than 5,000 tons of ore and are high in silica. Thus far no economical means of lowering the silica content has been devised. Hence, mining of manganese in California depends principally upon (1) a price sufficient to enable operators to pay the cost of concentrating the ore, and (2) specifications which will permit a high silica content. Such conditions have prevailed in the past only during periods of war.

Geologic investigations of California manganese deposits have also been concentrated for the most part during war periods, because during times of war, manganese becomes a critical mineral, and the need for procuring domestic manganese is great. Summaries of the results of investigations during the two world wars have been published by the California Division of Mines as Bulletin 76 [1] in 1918, which presents information compiled by the California Mining Bureau during World War I, and Bulletin 125 [2] in 1943, which summarizes data procured by

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* Published by permission of the Director, United States Geological Survey, Manuscript submitted for publication February 9, 1949.

[1] Bradley, Walter W., Huguenin, Emile, Logan, C. A., Tucker, W. B., and Waring, C. A., Manganese and chromium in California; California Min. Bur. Bull. 76, 248 pp., 1918.

[2] Jenkins, Olaf P., Manganese in California, including outline geologic map of California showing locations of manganese properties: California Div. Mines Bull. 125, 387 pp., 1943.

the U. S. Geological Survey in World War II, and in addition includes information on production, ore minerals, uses, types of deposits, theories of origin, and extensive bibliographies on manganese. Bulletin 125 also contains a map of the known deposits of manganese and a summary table showing the location, ownership, production, and type of ore body for the manganese deposits of record in California.

The object of the present report is to describe in detail the individual manganese deposits in California. It thus supplements Bulletin 125, which is essentially a summary. In the early part of World War II, the active and the potentially productive manganese deposits in California were examined by members of the staff of the U. S. Geological Survey. The present report is based upon a comprehensive report of these investigations, prepared in 1943 by the writer and his associates for official use of the Survey.

Particular attention is called to parts of the present report which contain previously unpublished geologic descriptions of two areas in which many manganese deposits are found: (1) the Ladd-Buckeye area in San Joaquin and Stanislaus Counties, and (2) the Black Wonder area in Santa Clara and Stanislaus Counties. These areas are 50 miles southeast of San Francisco on the east side of the central Coast Ranges of California. In 1940 when war seemed imminent, D. F. Hewett, geologist in charge of strategic minerals investigations for the U. S. Geological Survey, started a program of investigation of typical areas in which strategic minerals were plentiful in order to determine the mode of occurrence of the different types of ore bodies. In the event of war, geologists would thus be better able to estimate the quantity of ore in the ground and to help guide operators in mining strategic minerals. In this program the writer was in charge of manganese investigations in California, and he was closely associated with the detailed work in the Ladd-Buckeye and Black Wonder areas.

The program of detailed investigations of manganese in California included the study of the ore minerals, but the advent of the war prevented the completion of such work. For details on types of ore minerals the reader is referred to work by Taliaferro and Hudson [3] representing results of their studies commenced during World War I. Another report of detailed investigations, on the Paymaster district in southeast California, was written by J. B. Hadley.[4]

As there was little opportunity to visit the manganese deposits in California after March 1943, the present report for the most part gives information as of that date. A few deposits were visited by Max D. Crittenden, Jr., of the U. S. Geological Survey during the summer of 1944, and the results of his observations are included. The production figures by counties given in table 2, are brought up to the end of 1946.

In summary, this report presents the known information on the manganese deposits of record in California, particularly the location and ownership of the deposits, the size and nature of the ore bodies, geologic maps of the rocks around them, the grade of the ore, the state of development of the properties, and past production. The report is intended as an aid to people who may wish to develop the manganese resources of California. It should be used in conjunction with Bulletin 125. For the benefit of persons who may not have access to Bulletin 125, but who may be interested in mining manganese, a section on guides to prospecting is included. This section is essentially a repetition of a similar section in Bulletin 125.

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[3] Taliaferro, N. L., and Hudson, F. S., Genesis of manganese deposits of the Coast Ranges of California: California Div. Mines Bull. 125, pp. 217-276, 1943.

Taliaferro, N. L., Manganese deposits of the Sierra Nevada, their genesis and metamorphism: California Div. Mines Bull. 125, pp. 277-332, 1943.

[4] Hadley, J. B., Manganese deposits in the Paymaster mining district, Imperial County, California: U. S. Geol. Survey Bull. 931-S, pp. 459-473, 1942.

PRODUCTION OF MANGANESE ORE

The production of manganese ore in California is summarized in tables 1 and 2. Table 1, based on statistics compiled by the California Division of Mines [5] presents the production for intervals of time from 1887 to 1946. The data in table 2, compiled from available sources by the writer and his associates, represents an attempt to estimate the actual number of tons of ore that was marketed. In recent years the production of manganese has been reported by the California Division of Mines in terms of calculated content of 45 percent manganese. As much of the ore produced between 1941 and 1946 contains less than 45 percent manganese, the figures in table 1 tend to be lower than the corresponding figures in table 2. Thus the production of 75,454 tons for the years 1942 to 1946, as computed upon the basis of the data used in table 1 corresponds to 88,406 tons in table 2. The average grade of ore during this period was less than 45 percent manganese. The production figures in the two tables for the period prior to 1942 are more nearly in accord, being 92,768 tons in table 1 and 96,791 tons in table 2. The second table covers a longer period of time than the first table.

Table 1. Production of manganese ore in California.

(From California Division of Mines Bulletin 137, p. 150, 1946.)

Period	Production in short tons		Value
	Total	Average per year	
1887-1889	2,553	851	$23,401
1890-1894	2,184	437	19,568
1895-1899	2,637	527	20,962
1900-1904	1,487	297	13,780
1905-1909	326	65	5,915
1910-1914	439	88	6,175
1915-1919	70,576	14,115	2,151,015
1920-1924	6,242	1,248	118,588
1925-1929	1,800	360	32,366
1930-1935	639	107	7,206
1936-1940	320	64	3,251
1941-1945	79,019	15,804	2,722,389
1946 [a]	0	0	0
Total	168,222	------------	$5,124,616

[a] Informal communication from Olaf P. Jenkins, Chief, California Division of Mines.

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[5] Symons, Henry H., California mineral production and directory of mineral producers for 1945: California Div. Mines Bull. 137, p. 51, 1946.

Table 2. Production of manganese ore in California, arranged by counties.

County	Number of known localities	Production in short tons		
		1867-1941	1942-1946	Total
Alameda	31	4,604	380	4,984
Amador	15	585	535	1,120
Butte	10	305	------	305
Calaveras	17	------	32	32
Colusa	3	------	80	80
Contra Costa	1	200	------	200
Del Norte	2	------	------	------
El Dorado	6	------	------	------
Fresno	8	33	------	33
Glenn	10	237	17	254
Humboldt	15	1,846	4,684	6,530
Imperial	11	4,545	3,306	7,851
Inyo	11	------	19	19
Kern	10	23	------	23
Lake	33	462	159	621
Los Angeles	4	168	------	168
Madera	6	------	------	------
Marin	6	[a]	159	159
Mariposa	7	250	74	324
Mendocino	61	9,837	3,250	13,087
Merced	1	------	------	------
Mono	6	------	10	10
Monterey	3	------	------	------
Napa	14	302	------	302
Nevada	15	185	383	568
Placer	7	100	19	119
Plumas	15	3,948	4,401	8,349
Riverside	12	6,754	8,152	14,906
San Benito	7	246	19	265
San Bernardino	21	1,563	11,426	12,989
San Diego	9	------	------	------
San Joaquin	7	32,250	2,667	34,917
San Luis Obispo	29	4,778	1,928	6,706
Santa Barbara	3	------	------	------
Santa Clara	45	3,148	5,794	8,942
Shasta	8	1,000	378	1,378
Siskiyou	31	50	677	727
Sonoma	18	1,499	164	1,663
Stanislaus	28	17,690	22,957	40,647
Tehama	7	------	------	------
Trinity	105	138	16,496	16,634
Tulare	5	------	240	240
Tuolumne	10	45	------	45
Yuba	2	------	------	------
Total	675	96,791	88,406	185,197

[a] Small production, but amount is not known.

According to table 1 the total California production is about 168,000 tons and to table 2 it is about 185,000 tons. As indicated in table 1, production declined from a rate of 850 tons a year from the late eighties to less than 100 tons a year shortly before World War I. The average production was approximately 15,000 tons a year for the period of World War I, reaching a maximum annual production of 26,000 tons in 1918. Following the war it declined rapidly and was less than 100 tons a year in the late thirties. Production rose again during World War II, averaging 16,000 tons for the period. It was 314 tons in 1940; 3,565 tons in 1941; 17,362 tons in 1942; 30,263 tons in 1944; 2,100 tons in 1945; and none at all in 1946.

As shown in table 2, manganese ore has been produced from 35 counties in California, of which 30 counties yielded nearly 100,000 tons prior to 1942, and 28 counties gave approximately 90,000 tons during the second World War. Stanislaus County leads, with a production of 40,000 tons divided equally between the two war periods. It is followed by San Joaquin County with 35,000 tons, mostly obtained during the World War I; Trinity County with nearly 17,000 tons, produced almost entirely during World War II; Riverside and Mendocino Counties with 15,000 and 13,000 tons, respectively, divided about equally between the two wars; and San Bernardino County with 13,000 tons of comparatively low-grade ore, mined largely during World War II. The other producing counties yielded less than 10,000 tons each.

AIDS TO PROSPECTING FOR MANGANESE

Manganese deposits are relatively easy to discover, because most manganese ore minerals either are black or when exposed to the air, turn black. The ore minerals also are heavy. Thus, when a person picks up a rock that is black or bluish-black, heavy and not particularly hard, he is likely to have a manganese ore mineral. He should attempt to learn the heft of the minerals, however, for manganese commonly stains rocks with a thin film of black oxide, which may cause the rocks to look like good ore, but when broken, it is seen that the manganese forms only a thin coating. If the rock is composed entirely of manganese minerals it will be considerably heavier than if the manganese forms only a veneer on the surface.

Manganese oxide is found in many forms, but for the purpose of prospecting in California only three types need be considered. One type, commonly referred to as psilomelane, is hard, flintlike, and steel gray in color. A second type, pyrolusite, is intensely black and is soft and sooty. A third type, called hausmannite, is reddish brown. Recent work by Fleischer and Richmond [6] has indicated that the mineralogy of manganese oxides is complicated, and for details the reader is referred to their paper. For the purpose of this report all black oxides will be referred to merely as black oxides, and the red oxide, as hausmannite. The term *psilomelane-type,* in places in this report is used for the hard black oxide; and the term *pyrolusite-type,* for the soft, sooty black oxide, Actually, however, some of the hard oxide is pyrolusite and some of the soft oxide is psilomelane. Correct identification can be made only by means of complicated mineralogical tests.

The red oxide, hausmannite (Mn_3O_4) is rich in manganese, containing 72 percent manganese when pure, whereas the black oxides have only a little more than 60 percent when pure. Hausmannite, as found in California, usually is mixed with impurities, and the average grade encountered is between 50 and 56 percent manganese. Ore of this grade, of course, is good ore. Because of its red color, operators have been known to throw it away as worthless, thinking that only black ore is good. When-ever a heavy, dark-red rock with a waxy or resinous luster is found within an ore body below black oxides, a sample should be assayed in order to ascertain whether or not it is hausmannite. Hausmannite might be mistaken for red chert, from which it can readily be distinguished by its greater weight.

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[6] Fleischer, Michael, and Richmond, W. E., Jr., The manganese oxide minerals, a preliminary report: Econ. Geology, vol. 38, p. 269-286, 1943.

The black oxides of iron, hematite, and magnetite, might possibly be confused with black oxides of manganese, because these minerals are found in some manganese deposits. Hematite can be distinguished from manganese oxides by the red powder it forms when it is crushed or is scratched on a hard white surface. Magnetite is magnetic, hard, and more metallic-looking than manganese oxides.

Most manganese ore bodies in California give away at depth to different types of manganese minerals than are found at the surface of the ground. These minerals found at depth are called primary minerals. The primary mineral for most of the manganese deposits in the California Coast Ranges is manganese carbonate, rhodochrosite. Most of the rhodochrosite found in California is white or light gray, and is granular and somewhat greasy in appearance. It looks much like dirty lump sugar, but is harder than sugar, as it cannot be scratched with a fingernail, though it can be scratched with a knife. When found in the ground it is heavy, dense, and difficult to break with a hammer. It effervesces or fizzes slightly when hydrochloric or muriatic acid is added to it. Blocks of this mineral when left on the ground soon become coated with a black film of oxide. Much of the primary rhodochrosite in California contains 35 to 43 percent manganese and is a valuable ore mineral. Operators are cautioned not to throw it away as worthless.

Rhodochrosite is also found in a pink crystalline form, usually in thin veins. No commercial deposits of pink rhodochrosite have yet been discovered in California.

Rhodonite, a manganese silicate, is the chief primary mineral in Siskiyou, Shasta, and eastern Trinity Counties, in the Sierra Nevada, and in Los Angeles and San Diego Counties. It is pink and may be confused with rhodochrosite, but ordinarily it is harder than rhodochrosite, as it can barely be scratched with a knife. Usually it is light purple and does not effervesce with acid. However in places it is mixed with fine-grained rhodochrosite and in such places the rock will fizz with acid, because of the presence of the carbonate. Hence, effervescence cannot be taken as indicating the absence of rhodonite. Rhodonite crystals commonly are bladed, whereas rhodochrosite crystals are nearly equal in all dimensions. Rhodonite is glassy in appearance in contrast with the somewhat greasy luster of granular rhodochrosite. The manganese content of pure rhodonite is 41 percent. Many California rhodonite deposits contain more than 35 percent manganese.

Rhodonite is the least desirable of the manganese ore minerals, as its content of silica is high, and it melts at a high temperature. Rhodonite ore ordinarily is not marketable. Bodies of rhodonite weather more slowly than those of rhodochrosite, with the result that the zone of oxidized ore overlying primary rhodonite is likely to be only a few feet thick. Thus operators prospecting in territory known to be characterized by rhodonite should bear in mind that ore bodies composed of black oxide at the surface of the ground are not likely to persist at depth.

The primary mineral in many places in the Coast Ranges is bementite, a hydrous manganese silicate of variable composition. The manganese content of bementite ranges between 15 and 40 percent. Rich specimens of this mineral are finely bladed and are dark honey brown to strawlike in color. They have a waxy luster and are so hard they barely can be scratched with a knife. Bementite sometimes is confused with chert, but the greater weight, waxy luster, and crystalline form help in distinguishing bementite from chert. Bementite weathers readily to form black oxides of manganese. The mineral in many places is mixed with rhodochrosite and alters to rich zones of black oxide ore.

A special colloidal form of manganese silicate, containing 15 to 35 percent manganese, called neotocite, is found in small quantities in several deposits in the Coast Ranges. Neotocite is dark red, yellow, or black, is shiny and resembles opal, and is commonly found in veins, usually near greenstone or basic igneous bodies. It is not the source of any large ore bodies in California.

Braunite, a complex mineral containing about 90 percent manganese oxides and 10 percent silica, appears to be primary in some California deposits. Ore deposits containing it are likely to persist to greater depth than deposits formed by surface oxidation. Braunite, as encountered in California ore bodies, contains from 40 to 50 percent manganese and 10 to 20 percent silica. It is a dark-gray or black, somewhat shiny mineral, having a splintery fracture. If treated with hydrochloric or muriatic acid in a test tube it forms a gelatinous mass when the acid is allowed to evaporate to dryness. Neotocite and bementite also may make a gelatinous mass upon treatment with acid, but these minerals can be distinguished from braunite by their light color.

Spessartite, the manganese garnet, is the principal primary mineral in a few deposits in the Sierra Nevada. This mineral is rich in silica and nowhere is used as an ore of manganese. Fresh crystals of spessartite are easily recognized because of their garnet shape and wine color.

In searching for manganese in California, the prospector should bear in mind that the deposits follow distinctive patterns in different parts of the state. In the Coast Ranges from San Luis Obispo County northward to the Mad River in Trinity County, the manganese material is found chiefly in narrow lenses in bodies of chert, usually white chert, in the Franciscan formation. The primary ore minerals generally are rhodochrosite and bementite, though braunite and hausmannite are found in a few places. The oxidized zone may range in depth from more than 100 feet on the top of a hill to less than a foot in the bottom of a creek. The ore bodies are rarely more than 5 feet wide or 200 feet long. They are elliptical or pancakelike in shape and generally are found in a highly inclined position parallel to the bedding. Few bodies extend more than 100 feet beneath the surface of the ground.

In the Sierra Nevada, in the Klamath Mountains, east of the divide between the Mad and Trinity Rivers, and in the eastern part of Los Angeles and San Diego Counties, the primary ore bodies are largely rhodonite and manganiferous chert, both of which are high in silica. Spessartite, the manganese garnet, occurs in a few places in the foothills in the central part of the Sierra Nevada. Most of the deposits are found in bodies of chert and jasper, which in places have been altered by heat and pressure to quartzite; such altered rocks are called metachert in this report. As the depth of oxidation of the manganese deposits in this area ordinarily is only a few feet, minable ore bodies are comparatively small. In the Braito mine in Plumas County, the primary mineral is braunite, and minable ore extends to considerable depth in the deposit. This ore body, however, is almost a unique exception to the general rule of rhodonite deposits in the Sierra Nevada.

In Siskiyou County prospectors are cautioned against bodies of manganiferous chert and quartzite which are stained black on the surface over large areas, but which have a very low content of manganese, at most only a few percent. Specimens from such deposits are light in weight and show fresh chert or fine-grained quartzite when broken.

In the area east of the Sierra Nevada and in the desert region of southeastern California, manganese is found mainly in fractured zones or in fissures in volcanic rocks. The planes of fracture usually are steeply inclined, and the broken zone adjacent to the fracture ordinarily is 2 to 10 feet wide. The primary ore consists of black oxides of manganese which are mixed with the fractured country rock adjacent to the fracture. Calcite is a common constituent at depth in the deposits, though it may be leached at the surface. Few fissure deposits contain more than 35 percent manganese at the surface of the ground, and many of them have less than 20 percent at a depth of 25 feet beneath the surface. Few deposits are known to persist to a depth of more than 100 feet.

Beds of sandstone and volcanic ash are impregnated with manganese oxide in a few places in the desert region. Such deposits are likely to be low in grade and unless a market exists for materials of such quality, they are not particularly attractive to operators.

CONTRIBUTING AUTHORS

The description of the individual manganese deposits given below represents the work of a large number of people. The sources of the descriptions fall in four groups: (1) information procured during World War II by geologists of the U. S. Geological Survey; (2) data obtained during World War I by geologists associated with the Committee of Scientific Research of the California Council of National Defense; (3) published reports, mostly publications of the California Division of Mines; and (4) miscellaneous sources chiefly from the files of the U. S. Geological Survey. Source of the data and the date at which the information was obtained are given at the beginning of each description.

The writer has attempted to present in a useful form the information obtained from all these sources. He has personally examined a large number of the manganese deposits in California and he has endeavored to edit and revise the available data in light of his experience; but the responsibility for the basic information for each deposit rests with the authority indicated at the beginning of the description.

The geologists of the staff of the U. S. Geological Survey between 1940 and 1944 whose work is reported here are: Edgar Bowles, Doak C. Cox, S. C. Creasey, Max D. Crittenden Jr., J. B. Hadley, Charles B. Hunt, S. G. Lasky, J. M. Nelson, H. P. Norbeck, W. G. Pierce, A. F. Shride, Frank S. Simons, Parker D. Trask, Fred D. Trauger, Charles R. Warren, and Ivan F. Wilson. Spangler Ricker of the U. S. Bureau of Mines also supplied some mine descriptions.

A considerable number of descriptions are based upon the comprehensive investigation of manganese deposits in 1917 and 1918 carried on under the direction of George D. Louderback, Chairman of the Committee of Scientific Research of the California State Council of National Defense. Most of the deposits known at that time were visited, and a detailed report of the investigations was prepared, but never published. This report was of great use to the geologists of the U. S. Geological Survey during World War II, because the descriptions in it were so complete that it was not necessary to re-examine many inactive deposits. The geologists responsible for the descriptions prepared in 1917 and 1918 are: Glen Alvey, Theo Crook, E. F. Davis, F. S. Hudson, R. R. Morse, N. L. Taliaferro, and Alfred O. Woodford.

The descriptions taken from published sources are presented in three ways in this report: (1) direct quotations; (2) slight modification of original text; and (3) condensation of original description; whichever seems most appropriate. A statement at the beginning of each such description indicates the procedure used.

The system of identification of the deposits used in Bulletin 125 of the California Division of Mines has been adopted in the present report. Each deposit or group of deposits in each county is given a number. The numbers run serially for each county. Thus, *Alameda 1* refers to deposit No. 1 in Alameda County. This deposit is the Bartlett deposit; *Alameda 5* refers to deposit No. 5 in Alameda County, which is the Camp Nine mine; and so on. Several descriptions represent groups of deposits or ore bodies found in the same general locality. For example, *Riverside 1* refers to the Arlington district, which contains several ore bodies located on different properties in this region. For the entire state, 675 descriptions, representing more than 800 ore bodies, are presented.

DESCRIPTION OF DEPOSITS

ALAMEDA COUNTY

No. 1. Bartlett Mine. (Modified slightly from original description in California Min. Bur. Rept. 11, p. 121, 1893.) A manganese mine has been opened by W. P. Bartlett in Mitchel Canyon, in sec. 6, T. 4 S., R. 4 E., in the Corral Hollow mining district, 16 miles from Tracy. It is recorded in the name of J. Taylor and Company of San Francisco, and H. H. Pitcher of Livermore. A well-defined ledge has been traced westward from the Bartlett mine to the Ladd mine (San Joaquin 5), a distance of 3.5 miles. The ledge at the Bartlett mine is more than 10 feet wide. At a depth of 5 feet the ore body is 20 inches wide and at a depth of 35 feet it is 3.5 feet wide. The manganese content of the ore ranges from 41 percent near the surface to 53 percent at a depth of 35 feet. The gangue rock is quartzose. The ore near the surface is hard and flinty but it becomes soft with depth. The ore bed strikes east and dips steeply south. The footwall is chert and the hanging wall is standstone. Most of the ore that has been mined is in sandstone. Production prior to 1892 is said to be 300 tons.

No. 2. Beraudiere Mine. (By E. F. Davis and F. S. Hudson, September 16, 1917.) The Beraudiere mine is owned by John M. Beraudiere of Livermore. It is in the NE¼NW¼ sec. 14, T. 4 S., R. 3 E., about a quarter of a mile north of the Arroyo Mocho road, 13 miles from Livermore. The ore is exposed in a drift 60 feet long, which terminates in a small glory hole 30 feet deep. The relations are not clear but from the available exposures, the ore bed, which is enclosed in thin-bedded greenish chert, appears to be folded into an anticline. The east limb of this fold strikes N. 20° E., and dips 50° SE; the west limb strikes N. 75° E. and dips 30° NW. The ore is massive black oxide containing numerous cores of white granular silica and ocherous material. The property produced 47 tons of ore to 1917.

No. 3. Black Jack Mine. (By E. F. Davis and F. S. Hudson, September 16, 1917.) The Black Jack mine owned by Horace T. Overacker of Livermore, is in the NW¼NE¼ sec. 14, T. 4 S., R. 3 E., 13.5 miles from Livermore. It lies 750 feet from the Arroyo Mocho road. A drift enters the hill in the footwall, and at a distance of 60 feet the ore body is reached. The drift continues 30 feet farther following the ore body along a course N. 20° W. At the point where the drift strikes the ore bed there is an 8-foot raise from which a second drift follows the ore body along a course N. 10° W. for 40 feet.

The ore body is a massive siliceous bed, which ranges in thickness from 1.7 to 4 feet and averages 2.5 feet. It lies parallel to the bedding of the enclosing gray radiolarian chert and shale. The strike ranges from N. 25° E. to N. 20° W., and the dip from 25° to 55° W. The roof of the upper drift follows a flat-lying fault which cuts off the ore bed. The ore body is, for the most part, composed of massive gray chert, with irregular pockets of siliceous oxide ore. The massive chert and the ore are cut by numerous veins of quartz. In the bedded chert which encloses the ore are a few small bodies of massive chert stained with manganese oxide. Past production from the Black Jack mine is 40 tons.

No. 4. Buckhorn Claim. (By E. F. Davis and Frank S. Hudson, September 22, 1917.) The Buckhorn claim is the property of Charles J. Janson. It is situated in the SW¼SE¼ sec. 31, T. 4 S., R. 4 E., half a mile west of the Halfway House. The Halfway House is 19 miles southeast of Livermore on the Arroyo Mocho road. The workings lie at an altitude of 2,700 feet, near the top of a well defined ridge running northeast from the Cedar Mountain Ridge. No work is being done on this property at the present time.

Three working places are on the property. The northernmost is a 30-foot incline running south into the hill. About 20 feet south of the incline is a small open cut. About 60 feet southeast is a larger open cut. The incline on this cut was driven along a 5-foot layer of massive chert which lies parallel to the enclosing thin-bedded green chert and shale. The strike of the beds is N. 35° W., and the dip is 30° W. A small amount of manganese oxide stains the massive chert. Near the entrance to the incline the upper foot of the massive bed is altered to a siliceous oxide ore. No ore was seen on the dump. The prospects are small for finding a commercial body of manganese ore at depth in this chert layer.

A small open cut 20 feet south of the incline exposes a 3-foot layer of massive chert with manganese stains, enclosed in shale. The large open cut exposes a bed of siliceous ore 1.5 feet thick and 10 feet long. The strike is N. 70° W. and the dip is 50° S. This ore layer occurs in bedded chert and shale in conformable relation. The grade is estimated to be 15 percent manganese.

No. 5. Camp Nine (Cummings, Merchant) Mine. (By E. F. Davis and Frank S. Hudson, September 15, 1917, and August 29, 1918.) The Camp Nine mine is owned by the Crocker Estate of San Francisco, and is under lease to Frank Cummings of Livermore. It is 9 miles from Livermore on the Arroyo Mocho road, in the NW¼ sec. 9, T. 4 S., R. 3 E. The mine is situated on the west bank of a small steep gulch which trends southwest to the Arroyo Mocho. The deposit was uncovered during the construction of the Arroyo Mocho road. The upper and older tunnel enters the hill a few yards north of the road, and the entrance of the lower tunnel lies south of the road. The upper and lower workings are, in places, connected by stopes along the ore zone.

The ore zone lies within a body of bedded radiolarian chert and shale. Within the chert a small body of arkosic sandstone lies from 12 to 25 feet stratigraphically above the zone of the ore. The ore body is exposed in the upper workings for a distance of 100 feet along the strike. It is overlain by thin-bedded whitish chert and underlain by green chert in massive layers a foot or more in thickness. The thickness of the ore ranges from a few inches to 3 feet, but the enclosing chert follows the pinchings and swellings of the ore in such a way that the whole forms a conformable sequence. The strike of the beds ranges from N. 15°-55° W. The dip is 50° S. The ore consists of manganese oxide carrying residual patches of iron-stained silica. Quartz veinlets cut the ore. Ten feet from the end of the drift, the ore bed is 3 feet thick and is divided into two layers by a 10-inch lens of massive green chert. The chert is cut by veins of white quartz, with which considerable blue amphibole is associated.

In the lower working, carbonate ore is exposed for 150 feet along the strike. The ore zone lies essentially parallel to the enclosing green, well-bedded chert and shale. The strike ranges from N. 35°-70° W. and the dip from 30° to 50° S. As little manganese is present in the enclosing chert, the ore zone is distinct from the adjacent rocks. The zone within which the ore occurs, when considered as a unit, ranges in thickness from 1 foot to 12 feet, owing to sudden pinches and swells. The average thickness is about 4.5 feet.

The ore-bearing zone is a single massive bed. The lower part of this zone is invariably a massive chert, which for the most part is grayish green, but locally is mottled with irregular patches of pale reddish brown. The upper part of the zone commonly consists of carbonate ore, which occurs in lenses or kidneys. The transition between the massive chert and the carbonate ore takes place within a few inches. The chert in this transition zone changes from massive chert, free from manganese, to a chert carrying small spherules of rhodochrosite. With a further increase in the amount of manganese carbonate, the spherules fuse together forming a rock composed of alternate layers of rhodochrosite and silica, in bands one millimeter or more in thickness. In places the ore consists of massive banded rhodochrosite. These bands are due to alternations of gray and pink carbonate and also to thin streaks of brownish material. They show a rude parallelism, which approaches the trend of the ore lens.

The ore overlies chert without apparent break. In detail, the course of the transition zone is irregular. As a rule, the upper limit of the carbonate ore is formed by the bedded chert which overlies the ore zone. At only one place in this mine was massive chert found between the ore and the overlying bedded chert. The thickness of the ore lenses varies considerably. Maximum thicknesses of 4 to 5 feet are common. The largest lens of ore yet discovered has a maximum thickness of 6.5 feet. The average thickness of the ore bodies as a whole is between 2 and 3 feet. In many places the carbonate ore pinches out and the ore zone is composed entirely of the massive chert. Such a pinching out of the ore is referred to by the miners as a ''break''.

The upper inch of the carbonate is always thoroughly oxidized, resulting in a narrow selvedge or ''casing'' of oxide ore. Wherever joint planes cut carbonate ore bodies, the walls of the fissure are oxidized. The selvedge of oxide ore present on the upper contact of the ore zone is very continuous and may persist from one body of carbonate to another, or may pass into a parting which is strongly stained by manganese oxide. This ''leader'' of oxide, and also the well marked contact of thin-bedded chert and massive chert is of great assistance in the search for new bodies of ore.

Veinlets of blue amphibole were found in the massive chert at several places in the lower workings. The amphibole was not found in the bedded chert. Massive chert, however, is not altered to glaucophane chert.

Mining prior to 1918 was confined to the lower level, where the ore horizon was followed for 200 feet along the strike. The dip is southwest at low angles. About 150 feet northwest of the southeast end of the proven ore, the ore bed tapers to 1 foot in thickness, and at 180 feet the drift is below the ore bed. At 200 feet a raise to the southwest cuts the continuation of the ore horizon, which at this point is a bed of massive chert, carrying no manganese. It is the opinion of the writers that drifting northwest along this bed would be good prospecting.

Two hundred yards N. 20° W. of the portal of the lower tunnel a boulder of ore of fair grade occurs in slide material derived from sandstone. As this point is 100 feet above the lower level, it seems likely that it is on the direct continuation of the ore zone. A depression on the hillside here may have been caused by the caving of an old tunnel. Prospecting is advisable here.

No. 6. Chaney (Winship-Doak, Winship-Donovan) Lease. (By Frank S. Simons, October 7, 1942.) The Chaney lease is in the NE¼ sec. 12, T. 4 S., R. 3 E., on land owned by Frank J. R. Rodriguez of Livermore, and is under lease to O. E. Chaney, of Tracy. The prospect lies 2 miles by road and an additional 2 miles by an old wagon road from the Arroyo Mocho road, and 15.5 miles from Livermore. It is described in California Mining Bureau Bulletin 76, p. 26, as the Donovan lease, but, according to Mr. Chaney, the section location in that bulletin is incorrect. The mine is on a steep hill 400 feet above Corral Hollow Creek.

A bed of manganese oxide ore 2 to 3 feet thick is exposed in a small gulch tributary to Corral Hollow Creek. The wall rocks, consisting of white chert, strike north and dip 35° E. The ore bed can be traced on the surface for only 10 feet. An inclined shaft has been sunk along the ore bed to a depth of 35 feet; and 75 feet below the shaft collar a tunnel, said to be 215 feet long, has been driven into the hill. It is said to be connected to the shaft by a complicated series of workings.

The ore bed ranges in thickness from 1 foot to 5 feet, and averages 2.5 feet. The oxide ore grades downward into rhodochrosite; no oxide is found below a depth of 35 feet. The structure is extremely complicated, and the complex system of underground workings appears to be exploratory in character, as little ore is in any of them. It is reported that 200 tons of ore was shipped from this mine during World War I. Evidently all of this ore came from the shaft.

At the bottom of the shaft the main ore bed is faulted off, and exploration underground has failed to find ore on the other side of the fault. At least two thin beds of high-grade rhodochrosite are exposed in the workings. These beds range in thickness from 6 inches to 1 foot. In some places the ore is nearly pure, coarse-grained carbonate, but in most places it is a banded mixture of rhodochrosite and neotocite. The carbonate ore probably contains at least 35 percent manganese.

The best chance for more oxide ore appears to be on the surface at each side of the shaft collar, although it is doubtful if much more ore will be found, as massive chert crops out along the strike 20 feet south of the shaft and no float is seen north of the shaft area. There is little hope of developing appreciable tonnage underground, although it is reported that the tunnel struck a 6-foot bed of ore just before operations ceased. As the tunnel is now caved, this statement cannot be verified.

No. 7. Corral Hollow Mine. (Modified slightly from original description in California Min. Bur. Rept. 13, p. 506, 1896.) O. W. Mendenhall's Corral Hollow mine is on the steep eastern slope of Corral Hollow, 14 miles southeast of Livermore, in sec. 22, T. 4 S., R. 3 E. The ore occurs in chert and shale, which dip 45° to 60° E. About 200 tons of good ore was mined near the surface. J. W. Merchant of Livermore is the lessee.

No. 8. Crosby Prospects. (By E. F. Davis and Frank S. Hudson, September 23, 1917.) The Crosby prospects are located on the west slope of the Arroyo del Valle on the east side of Rocky Ridge, on the property of Mr. William Crosby, in the SE¼SW¼ sec. 30, T. 4 S., R. 3 E. The prospects are reached by trail, and are half a mile south of the Crosby house, which is 12 miles from Livermore by road up the Arroyo del Valle. In the northern and better of the two prospects, a large block containing about 50 tons of siliceous ore is exposed on the surface. It is underlain by well-bedded chert and shale, whereas the upper contact is obscured by soil. Little prospecting has been done, the work consisting of a small amount of trenching around the large block. The chert strikes N. 60° E. and dips 30° S.

The other prospect is 500 feet to the southwest. Here a small trench exposes a 3-foot bed of massive chert, cut by a few veinlets of manganese oxide. The strike is N. 30° E., the dip, 40° NW. A few pounds of oxide ore are on the dump, but their source is not apparent. It seems probable that additional trenching will open up a definite ore body in the northern prospect. However, a few grains of carbonate were seen in the surface material, and hence it is likely that the oxidized ore will persist to only slight depth.

No. 9. Dewhirst Mine. (By E. F. Davis and Frank S. Hudson, September 9, 1917.) The Dewhirst mine is owned by Mrs. Amanda Dewhirst of Livermore, and is under lease to McDonald and Clark of Oakland. It is 12 miles southeast of Livermore by the Cedar Mountain Road, in the NE¼SW¼ sec. 22, T. 4 S., R. 3 E. The mine is on the east side of the Cedar Mountain Ridge at an altitude of 3,100 feet, about 800 feet northeast of a knoll, 400 feet east of the old road to the Dewhirst house, at the northeast end of an open area near a blue oak and a Digger pine tree, on the east slope 50 feet above the bottom of the gully.

The ore is exposed in an open cut and in a drift from which a stope extends almost to the surface. The ore body is a lens of massive siliceous ore, striking east and dipping 50° S. This lens is underlain conformably by 5 feet of massive white chert, containing a few streaks of manganese oxide that run parallel to the bedding. Below this massive chert is thin-bedded chert with shale partings. Above the ore body are 3 feet of massive chert partings, containing a few thin laminae of shale. The massive chert carries numerous quartz veins. Above it lie thin-bedded chert and shale. The ore body and the enclosing massive chert are essentially parallel to the enclosing thin-bedded chert. The ore body is decidedly lenticular and has a maximum thickness of 30 inches. The east end of the lens is exposed in a stope, but the west end is covered by soil. The thickness of the bed decreases rapidly from east to west.

The lower part of the ore bed, at its west end, contains thin layers of cream-colored shale and patches of red and yellow ocher. It is cut by numerous quartz veins. At one place the massive chert above the ore body contains small veinlets and impregnations of a blue amphibole resembling glaucophane. This blue amphibole was found within 2 inches of the ore body but none was found in the ore body, and none of the enclosing thin-bedded chert and shale shows any evidence of metamorphism.

The ore contains about 40 percent manganese and 15 to 20 percent silica. About 30 tons of ore has been extracted and sacked for shipment. This material is estimated to run over 20 percent silica.

No. 10. Dyer Prospect. (By Frank S. Simons and Ivan F. Wilson, June 2, 1942.) The Dyer prospect is in sec. 17, T. 2 S., R. 3 E., on the Dyer Estate. The land is leased for sheep raising by G. F. Elliot. The prospect is 1 mile from Altamont, on the Western Pacific Railroad.

At numerous places on the Dyer Estate irregular pebbles of hard manganese oxide occur in the soil. The pebbles are in a roughly linear belt which is half a mile long, and 100 feet wide. The belt strikes north and dips gently east. The pebbles range from ½-inch to 3 inches in greatest diameter, the average being 1½ inches. They are irregular in shape, and consist of interlacing veins of psilomelane in a soft rusty-colored limy matrix. The surface of the ore consists of tiny radiating needles of well crystallized pyrolusite.

Half a mile east of the main occurrence of the pebbles, a bed of limestone and shaly limestone conglomerate crops out. This bed, which strikes north, is part of a conglomerate in the Panoche formation (Upper Cretaceous). Among the pebbles of the conglomerate are a few pebbles of white chert and manganese oxide. It is believed that a similar conglomerate bed is the source of the manganese oxide pebbles found farther west. The main occurrence, in a more or less regular belt, also suggests this conclusion.

The manner of occurrence indicates that the prospect has little economic value. The concentration of pebbles of manganese oxide in the source bed is too low to make the ore commercially attractive. There is no reason to think that any greater amount of ore will be found with depth. Judging by the number of pebbles found, it is doubtful if more than 5 tons of ore averaging 30 to 35 percent manganese can be found on the property.

No. 11. Ellis Ranch Deposit. (California Min. Bur. Bull. 76, p. 26, 1918.) "A small vein of manganese ore has been exposed by an open cut on the ranch of Edward T. Ellis, eight miles southeast of Livermore on the Tesla road, in sec. 28, T. 3 S., R. 3 E. Two small cuts, about ten feet apart, have been made on the vein which outcrops near the bottom of a gulch one-fourth of a mile south of the road. The ore is hard and blue black in color. Where exposed it was about 18″ in width. About ten tons of good ore was lying on the two dumps.''

No. 12. The Freitas Prospect. (By F. S. Hudson and G. H. Alvey, August 29, 1918.) The Freitas prospect is located in the NE¼SE¼ sec. 8, T. 4 S., R. 3 E., in Alameda County. It is said to be on the land of a Mr. Freitas. A small open cut exposes a massive bed of manganese-bearing material, composed of maroon chert, porous pink silica, and thin seams of manganese oxide. The relations of this body to the adjacent rocks are uncertain, but it appears to be overlain to the south by greenstone. Ten tons of material has been mined and stacked. The grade averages better than 50 percent silica. No shipping ore could be recovered by hand-sorting.

No. 13. Friggel Prospect. (By E. F. Davis and Frank S. Hudson, September 9, 1917). The Friggel prospect is on the property of R. Friggel in the NW¼ sec. 22, T. 4 S., R. 3 E., near the north line of the section. Here several large blocks of siliceous manganese ore lie in soil and broken chert. The relations are not clear but the material seems to owe its present position to landsliding. No material of commercial value was seen.

No. 14. Gallagher Deposit. (Files of U. S. Geological Survey, 1918.) A deposit owned by Dan Gallagher is in sec. 13, T. 4 S., R. 3 E., and sec. 19, T. 4 S., R. 4 E. A few tons of ore containing about 42 percent manganese are reported to have been produced in 1916 and 1917. Three tunnels were driven. The deposit is said to be unpromising.

No. 15. Graves (Ace of Diamonds, Alta, Black Gopher, Forget-Me-Not, Gray Fox) Claims. (From files of U. S. Geological Survey, 1918.) The Graves claims are located in secs. 7 and 18, T. 5 S., R. 4 E., and sec. 12, T. 5 S., R. 3 E. The total production is reported as 212 tons in 1918 and 1919, averaging about 40 percent manganese and 15 percent silica.

No. 16. Hearst Mine. (Condensed from original description in California Min. Bur. Rept. 13, p. 506, 1896.) The Hearst mine owned by J. W. Hearst, is located in sec. 30, T. 4 S., R. 4 E. When seen it was not sufficiently developed to determine the extent of the ore.

No. 17. Homestead Deposit. (E. C. Harder, Manganese deposits of the United States: U. S. Geol. Survey Bull. 427, p. 160, 1910.) The Homestead deposit is mentioned as lying southeast of Livermore, but no details are given.

No. 18. Isler (Eylar, Eiler) Mountain Deposit. (E. C. Harder, op. cit.) Like the Homestead deposit (Alameda 17) the Isler Mountain deposit is said to be located southeast of Livermore.

No. 19. Jumbo Prospect. (By E. F. Davis and F. S. Hudson, September 16, 1917.) The Jumbo prospect is owned by Horace T. Overacker of Livermore. It is in the NE¼NE¼ sec. 14, T. 4 S., R. 3 E., and is about 1,000 feet from the Arroyo Mocho road, 13.5 miles south of Livermore. The ore body is exposed in a small open cut and in a short drift 10 feet long. The ore body consists of a lens of massive chert which has a maximum thickness of 6 feet and tapers rapidly to a few inches. It is folded into an anticline, which plunges to the south, and the main body of the lens on the southwest limb of the fold, dipping 25° S. The ore body is enclosed within gray radiolarian chert and lies essentially parallel to the bedding. The ore body consists largely of massive gray chert with pockets and bands of manganese oxide. The manganese oxide contains a considerable admixture of silica, and locally shows cores of ocherous material and skeletons of radiolaria (?). No ore is in sight, but the prospect would justify additional exploration.

About 500 feet south of the Jumbo prospect, a tunnel running due north was driven into the hill. It passes through a body of chert and enters a mass of sandstone and shale. Just outside the tunnel, in an open trench, 3 feet of green massive chert is exposed. It is stained with manganese and lies within bedded chert and shale. A small amount of good ore was obtained near the surface. The chances of developing an ore body here appear unfavorable.

Farther down the same ridge below the road, another body of very siliceous ore is exposed in a small trench. Here also is little prospect of developing good ore.

No. 20. Kelly Mine. (By E. F. Davis and F. S. Hudson, September 15, 1917.) The Kelly mine is owned by Mrs. Kelly of Livermore, and is being worked under lease by Holbrook and McGuire. It is in the SE¼NW¼ sec. 5, T. 4 S., R. 3 E. It lies about 1 mile northeast of the Arroyo Mocho Road, 8 miles south of Livermore, at an altitude of 1,450 feet. There are two ore bodies, the northern of which has been opened by a 25-foot shaft. Both ore bodies have been exposed by surface trenching.

The northern ore body is 5 to 7 feet thick, and the southern ore body, which is separated from the first by 6 feet of barren chert, is at least 3 feet thick. Only one wall of the southern bed is exposed. The ore beds consist of massive siliceous ore and lie parallel to the bedding of the enclosing thin-bedded green chert and shale. The strike is N. 65° W. Near the surface the beds are vertical, but near the bottom of the shaft the dip is to the north at a high angle.

The ore minerals are oxides of manganese, carrying a variable quantity of white granular silica in irregular patches. Psilomelane is the principal metalliferous constituent of the ore, but near the surface a small quantity of manganese dioxide is present. The ore in the northern body becomes noticeably higher in silica as the hanging wall is approached. Fair ore is present in pockets of rather large size, but hand sorting will have to be employed in order to separate it from the more siliceous material. The outcrop of the northern ore bed is traceable for 150 feet. The southern bed does not appear to be so persistent. The outcrops of the ore bodies are marked by large blocks of siliceous ore in the soil. Most of this ore is too high in silica to be marketed without resort to some process of concentration. The friability of the ore would make crushing easy and inexpensive.

No. 21. Livermore Deposit. (From files of U. S. Geological Survey, 1918.) The Livermore deposit is said to have been leased to the Noble Electric Steel Company. It may be the same as the Bartlett deposit (No. 1). The production is given as 281 tons in 1916, and the grade as 40 percent manganese.

No. 22. Man Ridge Mine (Elliott, Noble, and Searles Lease, Scott and Winegar Properties). (By Frank S. Simons, October 8, 1942.) The Man Ridge mine, formerly known as the Scott and Winegar mine, is in sec. 7, T. 5 S., R. 4 E., on the south side of Man Ridge. The property is half a mile by trail and 4 miles by road from the Arroyo Mocho road, and 26 miles south of Livermore. It is owned by Phil Winegar and Arthur Most.

The southeast workings of the Man Ridge mine were developed by the Noble Electric Steel Company in 1917, and 600 tons of ore was produced. There are two cuts, now partly caved. The east cut exposes interbedded shaly chert and sandstone striking N. 45° W. and dipping 20° NE. A few thin stringers of manganese oxide are interbedded with the shaly chert, and much of the chert and some sandstone is coated with manganese oxide, but practically no ore is present. At the second cut 200 feet west of the first, a bed of siliceous manganese oxide 4 feet thick is exposed at two places. The general strike of the enclosing shaly chert is N. 45° E., and the dip is 15° NW. The ore bed is overlain by 1 foot of shaly chert, which in turn is overlain by sandstone. The ore bed is folded at the east end and strikes N. 60° W. The probable length of the ore bed is 35 feet, and the average manganese content of the ore is between 10 and 15 percent.

The northwest workings were developed by Elliott and Searles in 1917, and 350 tons of ore was produced. The workings consist of two large open cuts and a short adit 400 feet northwest of the southeast workings. The upper cut, 60 feet long, exposes a bed of siliceous manganese oxide striking N. 15° E. and dipping 25° NW. The ore bed lies nearly parallel to the slope of the hill, and is overlain by a few feet of shaly chert and sandstone. The bed is at least 3 feet thick, the total thickness being unexposed. The ore is siliceous, averaging 15 to 20 percent manganese. It would be difficult to sort to a higher grade. The ore bed may not extend uphill from the cut, as no float is in that area.

The lower cut, 50 feet below, shows what appears to be a bed of siliceous manganese oxide ore forming a dip slope. The area between the two cuts 7,500 square feet in area, is strewn with fragments of oxide. Some of the ore in the lower cut is high grade and represents a thoroughly leached remnant of a more siliceous ore. Two tons on a stock pile averaged 45 percent manganese, but the average grade of ore is about 25 percent manganese. The slope from the cut to the canyon bottom 50 feet below is covered with blocks of similar ore.

A tunnel near the west end of the lower cut has been driven into the hill at least 40 feet, but it was not entered as it was partly caved and in heavy ground. The tunnel apparently is almost entirely below the ore bed, because, according to Mr. Winegar, ore is exposed only near the portal.

The entire surface between the two cuts at the Elliott and Searles property appears to be underlain by siliceous ore containing some 20 percent manganese. Much of the original ore bed has been thoroughly weathered, and this part of the bed can be fairly easily sorted to ore of higher grade, but the unaltered massive ore of the upper cut can be sorted only with difficulty. Mr. Winegar plans to strip the surface in the area, and this method of exploration seems most suitable for such a deposit.

No. 23. Mendenhall Mine. (Modified slightly from original description in California Min. Bur. Rept. 12, p. 329, 1894.) The Mendenhall mine is half a mile south of the Cedar Mountain Road, 11 miles southeast of Livermore in the NE¼ sec. 12, T. 4 S., R. 3 E. In 1893 this mine produced 120 tons of good ore. The vein became narrow at depth and work was suspended.

No. 24. Mount Hamilton Deposit. (From files of U. S. Geological Survey, 1918.) A deposit worked by Walton Van Winkle of Berkeley in 1917, is said to lie near Mount Hamilton. Details are lacking.

No. 25. Nelson (Bailey Mine, Newhall) Lease. (By Frank S. Simons, October 1942.) The Nelson lease, formerly known as the Bailey mine or the Newhall lease, is in the NW¼ sec. 10, T. 4 S., R. 3 E., half a mile by air line from the Arroyo Mocho road, 10 miles south of Livermore. The mine is 56 miles from Patterson, the delivery point. It is on the property of the Holm ranch, and is leased by a Mr. Nelson of Alameda, California. The mine produced 200 tons of ore in 1918.

The main deposit of the area is on the crest of a low ridge near the boundary line between secs. 9 and 10. Here an open cut 50 feet long and 15 feet wide exposes a bed of manganese ore striking N. 30° E. and dipping 80° E. The ore continues for 40 feet north of the end of the cut, and apparently pinches out at that point. It also extends 10 feet south of the cut, beyond which are no outcrops. The ore consists largely of thin veins of manganese oxide in shaly chert. The ore body is 6 feet thick near the center of the cut, and probably lenses out both north and south. The wall rocks are shaly buff and brown chert. The manganese oxide has migrated considerably along cracks in the chert matrix. The chert is porous, and the porous parts near the surface have been filled with oxide. This porosity decreases with depth, as shown in the walls of a 20-foot shaft near the center of the cut, where the ore at the bottom of the shaft is harder and of lower grade than that near the surface. No massive oxide ore was seen. Fifteen feet east of the north end of the cut a small amount of low-grade oxide ore has been found in a pit 2 feet deep.

About 75 tons of ore has been piled near the cut. The stock pile is said to assay 29 percent manganese. The writer estimates that the stock pile will not contain over 20 percent manganese, and perhaps less. Moreover, the great porosity of the chert at the surface probably does not continue to any great depth, and with a decrease in porosity this ore will become lower in grade. The best ore will probably be found near the surface.

Several outcrops of similar ore lie on the ridge trending southwest from this deposit, but none appears to have any promise. On the east side of the canyon below the main working, and on the same strike as the old Bailey mine, an open cut and short adit expose a bed of oxide ore, about 1 foot thick, in shaly chert. Both walls of the ore are faulted, and the relations at depth cannot be predicted. The strike is N. 80° E., the dip is 55° S. The grade of most of the ore is low, perhaps 20 percent manganese, but a small amount of 35 percent ore lies on the dump. The total amount of ore in sight is negligible. About 150 feet above this cut an open cut exposes 5 feet of siliceous manganese oxide ore. This exposure is along the strike of the lower cut. The ore bed strikes N. 80° E., and dips 70° S. According to Mr. Williams, ore is found in several places on the intervening slope, now covered with wash.

Two hundred feet southeast of the upper cut an open cut and small stope expose a bed of oxide ore ranging in thickness from 1 foot to 3 feet. The wall rocks are shaly chert, minutely fractured, and the occurrence suggests a landslide of a single large block. The beds strike N. 30° W., and dip 40° NE. This attitude is at a decided variance with the prevailing structure of the area and that of sandstone nearby. Ten tons of ore, containing 20 to 25 percent manganese, is piled on the dump, and probably not more than 50 or 100 tons is available in all.

No. 26. Newman (Estacia) Property. (By E. F. Davis and F. S. Hudson, September 9, 1917.) One large body of manganese ore, two small prospects and an interesting but economically unimportant occurrence of "bog manganese ore," are on the property of Harry Newman, 12 miles southeast of Livermore. The largest of these deposits lies in the W½SW¼ sec. 22, T. 4 S., R. 3 E., at an altitude of 3,150 feet. It is under lease to McDonald and Clark of Oakland, but no work has been done. The ore is in a massive siliceous bed, enclosed in, and conformable to, well-bedded green radiolarian chert and shale. Past production is 350 tons.

At the main working, an open cut exposes the bed for a distance of 150 feet along the strike. The dip varies from 10° to 30° SW., slightly steeper than the slope of the hill at this point. The thickness of the ore bed varies from 2 to 3 feet, with an average of 2.5 feet.

The ore body contains small pockets of ore of good quality, but for the most part it is siliceous. Much material which would otherwise be good ore is rendered useless by the presence of numerous veins of quartz. None of the exposed ore body would yield ore without hand sorting.

About 230 feet northwest of the main working, a small pit exposes oxide ore in the chert. Since the attitude of the ore body conforms so closely with the slope of the hill, additional prospecting would not be expensive, and it is probable that bodies of good ore would be opened up in this way.

In the north center of the SW¼ sec. 22, about 250 feet northwest of the Dewhirst house, a small open cut exposes a 2-foot body of ore. The ore lies parallel to the bedding of the enclosed gray chert, dipping 55° W. No ore of commercial value was seen. The rock was highly siliceous originally and has been cut by veins of secondary quartz.

A few yards north of Mr. Newman's house in the SW¼NW¼ sec. 22, a small trench exposes heavy stains of manganese oxide in bedded chert. No definite ore body has been uncovered at this place.

About 50 yards west of the house is a spring in the bed of a small gulch. This spring has produced a deposit of so-called "bog manganese." A small trench shows the mode of occurrence of this material. The soil and rock fragments in the bottom of the gulch have been cemented by manganese oxide. In the winter the soil around the spring is said to be thoroughly saturated with water; it is stated that on reaching the surface of the water, manganese oxide separates in the form of a fine black slime. The prospect last described lies on the ridge above the spring, and it seems probable that the manganese oxide of the "bog ore" is derived by leaching from the chert in this ridge.

No. 27. Reay Deposit. (Condensed from original description in California Min. Bur. Bull. 76, p. 28, 1918.) W. R. Reay of San Francisco owns a deposit in sec. 36, T. 3 S., R. 3 E. One exposure of ore is on the line between secs. 35 and 36; another lies 300 yards to the east. Near the top of the ridge and farther east, well within the boundaries of sec. 36, is a large outcrop of chert mixed with the black oxide of manganese. Other occurrences of manganese have also been reported from this section.

No. 28. Root Deposit. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 28, 1918.) J. W. Root of Livermore reported in May 1918 that he had ready to haul, four carloads of manganese ore which he had mined from a recently located claim on Man Ridge. His property is on the southwest side of the ridge in either sec. 7 or 18 of T. 5 S., R. 4 E.

No. 29. Section 14 Mine. (By Frank S. Simons, October 8, 1942.) The Section 14 mine is in the NE¼NE¼ sec. 14, T. 5 S., R. 3 E., on the south slope of Man Ridge. The property is 5.8 miles by road from the Arroyo Mocho road and 28 miles south of Livermore. It is owned by Lee Ogler of San Jose, and is leased by Phil Winegar of Vernalis.

This mine was worked for a short time in 1918, and 700 tons of ore is said to have been shipped, the grade averaging better than 45 percent manganese. Development work consists of a tunnel driven S. 60° E. along the ore bed, and of a raise to the surface. The tunnel is now completely caved, but the raise is open for a short distance below the ground, although no ore is visible in the accessible workings.

The ore bed apparently had a strike length of 75 feet, an average thickness of 4 feet, and was more or less continuous to a depth of at least 40 feet. The rocks now exposed are badly faulted. The hanging wall of the ore apparently is a fault, with sandstone brought against ore. The general strike is N. 60° W., and the dip is steep to the northeast. The footwall is white chert. Most of the ore now visible does not contain more than 25 percent manganese, but a small amount will run around 45 percent. A 15-foot shaft near the tunnel portal encountered rhodochrosite ore, and some of this ore remains in the collapsed ore bin. The carbonate is all more or less completely oxidized, but small cores of unoxidized rock remain in the ore found in the shaft. The carbonate ore is of good grade. Even unoxidized ore contains about 40 percent manganese.

The future possibilities of this mine are difficult to evaluate, owing to the scarcity of outcrops and the caving of the old workings. Mr. Winegar plans to open the old tunnel and to clean out the shaft. It is thought that the good grade or carbonate ore which may be found would justify the expenditure of a small amount of money for reopening the mine, but the amount of ore that may be found cannot be predicted. No ore is in sight at present.

No. 30. Taylor and Pitcher. (Modified slightly from original description in California Min. Bur. Rept. 12, p. 329, 1894, and Rept. 13, p. 506, 1896.) The Taylor and Pitcher deposit is on the east side of Corral Hollow, 15 miles southeast of Livermore, probably in sec. 1, T. 4 S., R. 3 E. About 300 tons of good ore is said to have been mined. Messrs. Taylor and Pitcher of Livermore are the owners.

No. 31. Winegar Deposit. (By Parker D. Trask, August 13, 1947.) A deposit owned by H. W. Winegar is 20 miles southeast of Livermore, in the ridge east of Arroyo Mocho, at the side of the Camp Bessie Road, in sec. 4, T. 5 S., R. 4 E. The country rocks are sandstone and shale. The deposit was explored first in 1917 and again in 1945. An adit was driven in the hill, 300 yards south of Mr. Scott's house at the end of an open cut 60 feet long and 15 feet wide, but when visited in 1947 the adit was caved. The beds strike N. 45° W. and dip 65° N. A little ore is said to have been produced.

AMADOR COUNTY

No. 1. Alexander Prospect. (By Ivan F. Wilson, August 31, 1942.) A prospect is located on property owned by Jack Alexander of Amador City, California, in sec. 29, T. 7 N., R. 11 E. It is 2.6 miles by road, east of Amador City. The nearest railroad is 7 miles southwest at Martell. Open cuts are located at two separate horizons on a southwestern slope. At the lowest ore zone are exposures of banded slaty metachert with bands and irregular patches of manganese and iron oxides. An open cut 10 feet long, 3 feet wide, and 5 feet deep has been constructed on the slope southwest of the manganiferous rock. About 2 feet of manganiferous metachert exposed for 20 feet contains 20 percent manganese. Mr. Alexander quoted assays of 19, 25, and 39 percent manganese. The metachert here strikes N. 50° W., and dips S. 70° NE. It is enclosed in schist of the Calaveras formation.

About 200 yards up the hill northeast of the first mentioned place is an open cut 15 feet long, 3 feet wide, with a pit in the center 10 feet deep, 5 feet long, and 3 feet wide. This cut exposed a bed 3 feet to 15 feet thick, consisting of iron oxides and limonite, with some manganese oxides intermingled near the base. All of the material is too low in manganese and too high in iron to be of shipping grade.

No. 2. The Big Gulch Claim. (By Ivan F. Wilson, August 29, 1942.) The Big Gulch claim is in the NW$\frac{1}{4}$ sec. 4, T. 7 N., R. 12 E., and was located on government land August 29, 1940, by G. W. Vose of Fiddletown. It may be reached by proceeding along the main road east of Fiddletown for 5 miles, then turning south along the road toward Helbing's Ranch for 0.6 mile. From this point it is accessible by a trail that turns first to the southwest, then swings around to the southeast and follows an abandoned irrigation ditch for half a mile. The nearest railroad is 23 miles away, at Martell on the Amador Central Railroad.

The claim is in an old hydraulic gold property below a lava cap of andesitic breccia. The manganese has been prospected by a few small shallow pits and by one cut 15 feet long, 3 feet wide, and 10 feet deep. These reveal a residual breccia with quartz fragments cemented by manganese oxides (chiefly psilomelane). This manganiferous material is mostly below 10 percent manganese. A few individual specimens were seen which might run 30 percent manganese. This is a superficial deposit, and no solid bed of manganese was seen. No commercial ore is in sight at the property.

No. 3. Custer (Dooley) Prospect. (By Ivan F. Wilson, August 30, 1942.) The Custer prospect (also known locally as the Dooley prospect) lies about 0.5 mile northwest of the Du Frene prospect (Amador 5) midway between Ione and Martell, probably in sec. 28, T. 6 N., R. 10 E. The prospect is located along the tracks of the Amador Central Railroad, 2,250 feet north of where the railroad crosses State Highway 88, 0.1 mile west of Sunny Brook Service Station and 5 miles west of Martell. The prospect is owned by R. J. Custer of Lodi.

This prospect is located in manganiferous metachert enclosed in metavolcanics and metatuffs which are similar in most respects to those occurring at the Du Frene prospect (Amador 5). The reader is referred to the report on that prospect for a more detailed description of the rocks and occurrence of the ore. The metachert is along the same general line of strike as in the Du Frene prospect, but it is not thought that the two beds are continuous because metavolcanics are the main rocks exposed between the two places. The strike of the beds at the Custer prospect is north, and the dip is 65° E. The metachert at this prospect is 5 to 6 feet thick, exposed over a total length of 48 feet from the south bank of the railroad cut to a shaft 6 feet by 6 feet and 20 feet deep just north of the railroad tracks. The metachert is massive to banded, in part recrystallized to fine-grained quartzite, but for the most part still chalcedonic, with some patches of white opal. A small amount of black manganese oxide occurs as bands and crusts in the metachert. Some of the metachert is minutely banded, with alternate thin layers of black oxides and chert. The total amount of black oxides exposed is slight, however, and none appears in masses large enough to separate by hand from the wall rock. No minable body of manganese oxide ore is in sight at this property.

No. 4. Deaver Prospect. (By Ivan F. Wilson, August 31, 1942.) A. H. Deaver of Fiddletown, has been given the right to prospect on property owned by Ed Hutchinson of Placerville. The property is located along the main road 3.6 miles east of Fiddletown, probably in sec. 31, T. 8 N., R. 12 E. The nearest railroad, the Amador Central, is at Martell, 21 miles by road southwest.

A few blocks of manganiferous rock were found in a road cut on the south side of the road. The loose material at this place includes some highly weathered fragments of a siliceous rock, possibly metachert, containing manganese and iron oxides. The manganese content is probably not over 10 percent. No bed of manganiferous rock was observed in place. In the vicinity are blocks of gray phyllite or sericite schist belonging to the Calaveras formation. No prospecting at this locality has been done other than exposing a few blocks in the road cut. No ore is now in sight at the property, and a statement regarding economic possibilities must await further prospecting.

No. 5. Du Frene Prospect. (By Ivan F. Wilson, August 20, 1942.) The Du Frene prospect is located midway between Ione and Martell 4.7 miles along State Highway 88, west of Martell, in the SW¼ sec. 27, T. 6 N., R. 10 E. It is on a bare, moderately steep, westerly hill slope 700 feet south of the road, and 0.3 mile east of Sunny Brook Service Station. It is 0.8 mile from Ranlett's siding on the Amador Central Railroad. The prospect is owned by Fred Du Frene of Ione.

Development consists of one shaft and a series of six open cuts or pits located at intervals along one ore bed over a total length of 250 feet.

The ore at the Du Frene prospect lies in a bed of manganiferous metachert 5 to 8 feet thick exposed over a length of 270 feet. The bed strikes N. 5°-15° W., and dips S. 65°-75° E. The metachert is enclosed in metavolcanics (in part greenstone) and metatuff, light green to gray when fresh, weathering brown, and varying from massive to slightly schistose. The rocks are exposed in the cut west of the ore body, and they also crop out at the surface at various places in the vicinity. The formation is thought to be the Amador group of Taliaferro. The top of the hill east of the ore is covered with old stream gravels, and these have slumped down over the ore bed in many places.

The metachert is massive to thick-bedded, in part chalcedonic to opaline, in part recrystallized to fine-grained quartzite. Some patches of white to yellow opal were noted. The color of the metachert varies from gray to red or brown. In one or two places the metachert is cut by bands or veinlets, 0.5 to 1 inch wide of a black metallic hard octahedral mineral which may be magnetite. Much of the metachert contains scattered grains or concentrated masses of a bright red vitreous mineral which may be reddish-stained quartz, or perhaps garnet.

The manganese oxides occur as bands, crusts, and pockets in the metachert; the amount of oxide ore present is very small. One small patch of pink rhodonite was noted. The dumps of many of the shallow cuts reveal mostly fragments of the reddish-stained metachert, with very little manganese oxide except crusts and coatings.

The best exposure of manganese oxides is in the southernmost cut, where a thickness of 1 foot to 2 feet near the center of the metachert is made up mostly of oxides, chiefly hard blue-black psilomelane. This ore bed probably contains 45 percent manganese. It is exposed for a length of 5 feet. The other cuts contain a few kidneys of fairly good ore up to 6 inches in diameter but more commonly the ore consists of bands or crusts of oxide (psilomelane and pyrolusite) from a fraction of an inch to 3 inches wide.

Some of the black oxide ore is of good grade, but the amount available is small. An assay of a sample taken by Bayliss C. Clark of Sutter Creek, ran 46.75 percent manganese, 3.36 percent iron, and 21.25 percent silica.

No. 6. The Eagle's Head Claim. (By Ivan F. Wilson, August 30, 1942.) The Eagle's Head claim was located by Harvey L. Helbing of Fiddletown, California, on April 16, 1941, on government land, in the N½ sec. 4, T. 7 N., R. 12 E. It is 6.6 miles by road east southeast of Fiddletown. It may be reached by proceeding along the main road east of Fiddletown for 5 miles, then turning south along the road toward Helbing's Ranch for 1.6 miles. From this point it is accessible by trail 0.3 mile west of the road. The nearest railroad, the Amador Central, is 24 miles distant at Martell.

This claim is in an abandoned hydraulic gold property below the same lava cap as that in the Big Gulch claim (Amador 2). Rhyolite tuff and clay occur at the base of the lava cap at this point. Below this is a deep residual breccia or soil. The manganese oxide (mainly psilomelane) occurs as coatings, irregular patches, and cement in this loose material. It is mixed with clay. Assays are said to run over 40 percent manganese, but while this might be true of an individual small specimen, the material in sight which would have to be mined would probably run less than 10 percent manganese. No solid bed of manganese ore was seen, and the deposit is superficial. Lateritic soil is nearby, containing hematite, limonite, and anauxite.

No manganese ore is in sight at this property.

No. 7. Everett Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 30, 1918.) L. Everett of Mokelumne Hill reports an undeveloped manganese prospect 4 miles east of Pine Grove. It probably is located in sec. 31, T. 7 N., R. 13 E.

No. 8. Germolis (Rodonick) Prospect. (By Ivan F. Wilson, August 29, 1942.) The Germolis prospect, known during the last war as the Rodoniek prospect, is in the NW¼ sec. 10, T. 7 N., R. 11 E., 3 miles by road south of Fiddletown. It is owned by Paul Germolis of Fiddletown. The property has been leased to Dr. J. T. Stacy of Sacramento, but the lease was cancelled in 1942. The nearest railroad, the Amador Central, is at Martell, 20.5 miles distant.

Development at this prospect consists of one open cut, 8 feet by 8 feet and 6 feet deep, on the south bank of a stream just south of the Germolis ranch house. The cut exposes a bed of massive, manganiferous metachert, penetrated by manganese oxides and containing pockets 3 to 4 inches wide of high-grade ore. The general run of the bed is probably fairly low grade, perhaps running 20 percent manganese. The metachert is recrystallized to fine-grained gray quartzite and is cut by narrow quartz veinlets. The bed of maganiferous metachert is 5 to 6 feet wide and is exposed in the cut and on the surface for a length of 32 feet. It strikes N 25° W., and dips 65° NE.

The massive metachert is enclosed in a belt at least 50 to 100 feet wide and 500 feet long. This belt consists of rhythmically bedded, white to gray metachert with darker-colored, original shale partings. The metachert occurs in beds 0.5 inch to 2 inches thick. It is recrystallized to fine-grained quartzite and has thin original shale partings which are recrystallized to fine-grained sericite schist. Many beds are strongly contorted. The manganiferous ore is well exposed in the bottom of the stream south of the Germolis ranch house. The belt continues along the slope west of the ranch house. A few small pockets and bands of manganese oxides are found in the bedded metachert, but no development has been done and no ore body large enough to be mined is now in sight.

Some fragments on one of the dumps consists of brown to pink rhodochrosite stained with black oxides. No other unoxidized manganese minerals were noted. The bed of manganiferous ore exposed is rather small, and most of it is low grade.

A general observation applicable to the Calaveras formation may be made here—that the largest masses of manganese ore occur within the massive metachert, rather than in the thin-bedded types with original shale partings.

No. 9. Jones Prospect. (By Ivan F. Wilson, August 28, 1942.) The Jones prospect is 1 mile west of Pine Grove in sec. 32, T. 7 N., R. 12 E. It was owned and developed by L. W. Jones of Pine Grove, during World War I, but is now owned by D. C. Stowe of Stockton. No recent development has been done. The prospect is on top of a hill 0.3 mile south of Jones Ranch, which is 1 mile west of Pine Grove along the road toward Sutter Springs. There is no road at present along the last quarter of a mile. The distance to the Amador Central Railroad at Martell is 9.5 miles.

The development at this prospect consists of a shaft 30 feet deep, from which an open cut 20 feet long runs S. 35° E. A drift 4 feet wide and 12 feet long has been run toward the west from the shaft. The drift and shaft expose massive, manganiferous metachert, recrystallized to fine-grained, white to gray quartzite. It is cut by veinlets containing thin beds of manganese oxide 1 inch to 3 inches thick and pockets of ore 1 foot to 3 feet thick. The ore is chiefly botryoidal and nodular psilomelane, with some pyrolusite. The strike of the beds is nearly east and the dip 70° N. The ore bed is exposed for a length of about 25 feet in the drift and shaft.

The massive metachert containing the ore is enclosed in rhythmically bedded metachert consisting of beds 1 inch to 3 inches thick separated by original shaly partings (now fine-grained schist) 0.1 to 0.2 inch thick. Manganese oxides occur locally along the shaly partings and in irregular areas penetrating the rock. The belt of metachert is at least 50 feet wide. It belongs to the Calaveras formation. Some ore was piled on dumps during World War I, but none was shipped. Five or ten tons on the dump should run over 40 percent manganese. Mr. Jones states that assays of samples taken during World War I ran 48 percent manganese, and 6 percent silica.

No. 10. Lubanko Prospect. (By Ivan F. Wilson, August 29, 1942.) The Lubanko prospect is 1.2 miles east of the Germolis prospect (Amador 8), in the SE¼ sec. 10, T. 7 N., R. 11 E. It is reached by driving 3 miles south of Fiddletown to the Germolis Ranch, then proceeding 1.2 miles east to the Lubanko Ranch. The prospect is on the south slope east of the Lubanko ranch house. It is owned by Louis Lubanko of Fiddletown, and is leased to Dr. J. T. Stacy, of Sacramento. No one was working at the property when it was visited. The prospect is 22 miles from Martell on the Amador Central Railroad.

Development includes an irregular-shaped cut 35 feet long, up to 10 feet wide and 10 feet deep, with two drifts started into the hill from this cut for a distance of 5 to 10 feet. This cut is located in and just west of a ravine. Up the slope 35 feet N. 35° E. of the ravine is another irregular-shaped cut 15 feet long, 10 feet wide, and 5 feet deep. The total length of the ore bed exposed by these cuts is 80 feet. The ore consists of lenses of manganese oxide contained in massive metachert. The massive metachert is enclosed in rhythmically bedded metachert with original shale partings. The small pockets of ore are in the bedded rocks, but the largest bodies of ore are in the massive rock. The metachert is recrystallized to fine-grained gray quartzite, and is cut by quartz veins up to 6 inches thick.

At least two different lenses 1 foot to 3 feet thick of high-grade black oxide, chiefly psilomelane with some pyrolusite, are exposed. These lenses grade into low-grade ore. Brown to pink rhodochrosite was seen as patches surrounded by black oxides, both in place and in fragments on the dump. This deposit is similar to the Germolis prospect in wall-rock oxide and rhodochrosite.

The general strike in the cuts is N. 50° E., and the dip 20° to 30° NW. However, in places the beds are nearly horizontal owing to hill creep. The well-bedded metachert continues at least 300 feet southwest of the cuts, exhibiting pockets of manganese oxides, 2 to 3 inches thick.

A few truck loads of ore were said to have been hauled from the property by J. T. Stacy and sold as part of a shipment of 30 tons from the Stirnaman prospect (Amador 15). They are reported to average 52 percent manganese, 3 percent iron, and 4.5 percent silica.

No. 11. Martell Mine. (From the files of the U. S. Geological Survey, 1918.) A mine called the Martell is reported to have yielded 35 tons of manganese in 1917. No other information is available.

No. 12. Pereni Prospect (Peyton et al. Lease). (By Ivan F. Wilson, August 20, 1942.) The Pereni prospect is 2 miles east of Pine Grove in the NW¼ sec. 35, T. 7 N., R. 12 E. It is owned by Ben Pereni of Pine Grove. This is the same prospect which is described in Bulletin 76 as the "Peyton et al. lease."[1] The prospect is on a fairly steep northerly slope 0.3 mile north of the Pereni Ranch, and about 0.5 mile north of the Peyton prospect (Amador 13.) The nearest railroad is the Amador Central at Martell, 13 miles west. During World War I one carload of ore was shipped from this and the Peyton prospect together, according to Mr. Peyton no development has been done since that time.

The principal development consists of an open cut 35 feet long, 7 to 8 feet wide, and 15 feet deep at the face. The cut trends S. 15° W. into the hill. A shaft 15 feet deep and 5 feet in diameter has been sunk from the center of this cut. A short drift runs from the bottom of the shaft. Another cut, 15 feet in length, is 50 feet S. 15° E. from the shaft. The main open cut and shaft reveal a thickness of 5 to 8 feet of massive, manganiferous metachert, containing ore pockets 1 foot to 3 feet thick, chiefly psilomelane. The metachert has been recrystallized to fine-grained quartzite. It is enclosed in quartz-mica schist, some of which is soft and crumbly, stained reddish, and resembles metatuff. The beds strike N. 15° E. and dip nearly vertically, or possibly slightly toward the east. The rocks are regarded as belonging to the Calaveras formation.

The shallow cut south of the main cut reveals a thickness of 15 feet of massive metachert, somewhat stained and penetrated by manganese oxide containing less than 10 percent manganese. The ore body is cut by quartz veinlets up to 0.5 inch thick.

Two or three tons of fairly good ore lies on the dump in front of the main cut. The ore is a mixture of pyrolusite and psilomelane, with yellow to white cherty cores, recrystallized to fine-grained quartzite and cut by small quartz veinlets. It would probably run about 40 percent manganese. Assays of some samples collected by Bayliss C. Clark, Sutter Creek, and analyzed by Smith, Emery & Company, San Francisco, were as follows:

Percentages			
Mn	*Fe*	*SiO_2*	
16.65	2.40	62.16	
28.52	—	27.20	
39.90	—	13.68	(north work dump)
19.10	2.13	57.06	(average)

The general average of the ore now exposed would probably be about 20 percent manganese, but pockets of ore containing 40 percent could probably be obtained.

No. 13. Peyton Prospect (Crocker-Preston Property). (By Ivan F. Wilson, August 26, 1942.) The Peyton prospect is located 3 miles east of Pine Grove in the SW¼ sec. 35, T. 7 N., R. 12 E. It is owned by Lee Peyton of Pine Grove. This ore body is the same as the Crocker-Preston property of World War I, described in Bulletin 76,[2] but it is not the same as the Peyton lease described in that bulletin. It may be reached either from the Peyton and Pereni ranches, between Pine Grove and Volcano, or by turning off from State Highway 88, 3.2 miles east of Pine Grove, and proceeding northwest along an unimproved road for 0.7 mile. The prospect is 14 miles by road from Martell on the Amador Central Railroad. During World War I about one carload of ore was shipped from this and the Pereni prospect (Peyton et al. lease) (Amador 12).

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[1] California Min. Bur. Bull. 76, p. 30, 1918.

[2] California Min. Bur. Bull. 76, p. 29, 1918.

The main development is on the crest of a small ridge. Here is located a crosscut tunnel 45 feet long, trending S. 80° W. into the hill. The cut is connected to the surface by two openings. At the west end a drift has been run to the north for 20 feet and another to the south for 10 feet. The main ore body is exposed by these drifts and the crosscut. A small shaft or pit is located 30 feet south-southwest of the crosscut. Another pit lies on the ridge 65 feet north of the crosscut. Down the slope to the northeast is an open cut 10 feet long, 6 feet wide, and 20 feet deep at the face. Another cut is 16 feet long, 5 feet wide, and 10 feet deep at the face. All the development was done during World War I except for the last mentioned cut, farthest down the slope, which was constructed recently.

The manganese ore at the Peyton prospect consists of pockets and lenses of black oxides, chiefly botryoidal, nodular psilomelane, with some pyrolusite, in massive metachert. The metachert has been metamorphosed in part to fine-grained white or gray quartzite, but is in part still unrecrystallized chert, white to brown in color. It is cut by a few small quartz veinlets. The metachert is enclosed in quartz sericite schist. Some of this resembles metatuff. More than one lens of metachert is enclosed in the quartz sericite schist. The general strike is N. 20°-25° W., and the dip is 60°-65° NE. The beds are regarded as belonging to the Calaveras formation.

In the crosscut tunnel three main lenses of ore lie in metachert. The one exposed for the greatest length is followed by the drifts at the west end of the crosscut. Here pockets and lenses of ore 0.5 foot to 3 feet thick are exposed for a length of 35 feet. The upper cut on the hill slope to the northeast reveals a bed of soft black oxide ore mostly pyrolusite, crossed by quartz veinlets. It is 1 foot wide and 20 feet long. This ore appears to be of shipping grade, possibly running 40 percent manganese. This bed apparently is different from the one exposed in the crosscut tunnel. The lowest cut on the hill slope reveals 1 foot to 2 feet of massive metachert containing manganese and iron oxides, but too low grade to be ore. Partly oxidized pink rhodonite is exposed in the metachert.

Assays of representative samples taken by Bayliss C. Clark of Sutter Creek, and assayed by Smith, Emery & Company of San Francisco, were as follows:

	Percentages		
Mn	*SiO_2*	*Fe*	
21.10	19.34		
11.07	31.18		(large chunks)
14.25	49.52		(soft ore)
25.45	36.56	6.51	(footwall contact)

However, it is thought that pockets and lenses are available which would be of shipping grade, perhaps 40 percent manganese.

No. 14. Ruhser and Hubberty Deposit. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 30, 1918.) A deposit of manganese half a mile southeast of Defender, probably in sec. 29, T. 7 N., R. 13 E., is said to have been worked by the Manganese Company of California in 1916. It is reported that 250 tons of ore was shipped and about 50 tons remains on the dump. The property is owned by F. W. Ruhser and Adam C. Hubberty of Jackson.

No. 15. Stirnaman Mine. (By Ivan F. Wilson, August 27, 1942.) The Stirnaman mine is between Pine Grove and Pioneer Station in the SE¼ sec. 24, T. 7 N., R. 12 E. It may be reached by road by turning off State Highway 88 to the north, 0.8 mile west of Pioneer Station. It is then 1.8 miles from the highway. First a road is followed for 0.3 mile to Smith Ranch; from there a road turns off to the northeast for an additional 1.5 miles. The prospect is located on top of a gentle ridge. The nearest railroad, the Amador Central, is at Martell, 16.5 miles west. The land is owned by Clyde Stirnaman of Ione, and the mineral rights by Mrs. Lydia E. Blakemore of Stockton. The property is leased to Dr. J. T. Stacy of Sacramento. E. J. Freels of Fiddletown is superintendent. No one was at work on the property when visited by the writer.

Development consists of open cuts and two main levels of stopes, with various connections to the surface. Some bulldozing has been done on the surface. The main open cut is 85 feet long, 7 to 8 feet wide, and 24 feet deep at the end. It trends into the ridge in the direction N. 40° E. At the end of this cut is the lower stope, 35 feet long, about 10 feet wide, and 10 to 15 feet high, at a level of 24 feet below the surface at its mouth. The upper stope is located above and continues northeast of the lower stope. It is 40 feet long, 15 feet wide, and 5 to 10 feet high. An open cut 25 feet long, 10 to 15 feet wide, and 10 to 15 feet deep lies northeast of the upper stope. Another cut has been started south of, and 10 feet lower than, the main cut. It is planned to drive a tunnel from this cut to strike the ore body at depth. Mr. Freels states that tunnels are also to be driven on the southwest side of the ridge at a level 68 feet below the top, and one on the northeast side about 125 feet below the top.

The manganese ore at this prospect occurs in lenses of massive metachert, which is recrystallized to fine-grained, white to gray quartzite. The metachert is rhythmically bedded and consists of layers 0.5 inch to 2 inches thick. Thin shale changed to sericite schist lies between the layers of metachert. The metachert forms a belt 30 to 50 feet wide surrounded by quartz-sericite schist. These beds belong to the Calaveras formation.

The manganese ore occurs as lenses from 1 foot to 8 feet in width in the massive metachert. More than one lens of ore is present, the exact number being uncertain because of the complex structural conditions. The ore is mostly psilomelane, which is hard, blue black to black, botryoidal and nodular, mixed with yellow iron oxide and clay. The ore is cut by thin stringers of quartz, but no large quartz veins are present. Parts of the ore are mixed with considerable quantities of metachert.

The structure is locally complex. The general strike is N. 20°-40° E., and the dip is 55°-65° SE. The chert is broken in places by faulting and folding. At the entrance to the lower stope an ore bed is apparently repeated by faulting. A vertical fault seemingly parallels the southeast wall of this stope and of the main open cut, for the beds to the northwest dip abruptly into vertical beds.

At the entrance to the upper stope, the beds are folded into an anticline which plunges northeast. The well-bedded metachert is considerably wrinkled near the crest of this structure. The anticline has prevented the ore bed from reaching the surface over a considerable area, although it has been stoped out a few feet below the surface. Some ore adheres to the roof of this upper stope in places, below the well-bedded metachert. Assays of two samples collected from this property by Bayliss C. Clark of Sutter Creek, and assayed by Smith, Emery & Company of San Francisco, showed the following results:

Percentages		
Mn	*Fe*	*SiO_2*
33.10	2.01	10.76
49.76	1.50	10.24

Some 250 tons of ore was shipped from this mine during World War I. Since Mr. Stacy took the property over, one shipment of 30 tons has been made, part of which consisted of ore from the Lubanko prospect (Amador 10). This ore was shipped to the Metals Reserve Company in Sacramento. The shipment is said to have 52 percent manganese, 3 percent iron, and 4.5 percent silica. The ore was obtained mainly from pockets in the upper stope and from other small scattered areas in the old workings.

The main ore bed is exposed at intervals on the floor of the main cut along the southeast side. At one point 3.5 feet of ore is exposed, of which the lower 2 feet is highly quartzose, but the upper 1.5 feet is high-grade ore. In a pit 6 feet deep and 8 feet wide, started from the bottom of the cut and extending southeast, 8 feet of ore is exposed, of which 2 or 3 feet is high grade. Fault gouge is at the top of the ore body at this point.

Part of an ore bed 2 to 3 feet wide has been left at the top of the lower stope on the northwest side. If this ore were removed, the whole surface of the lower stope would probably cave in. In a small drift extending southeast from the lower stope, 1 foot of fair ore is exposed. Siliceous ore is exposed in a shaft northwest of the lower stope. Pockets of ore 2 to 3 feet thick are still present in the upper stope.

BUTTE COUNTY

No. 1. Bear Canyon. (By J. M. Nelson, 1941.) The Bear Canyon deposit is in sec. 34, T. 20 N., R. 7 E., about 30 miles from the railroad at Oroville. It is owned by George W. Wooley, and in 1916 produced 305 tons of ore averaging 45 percent manganese and 10 percent silica. The deposit is 35 feet long and 4 feet wide. It has been opened to a depth of 20 feet by means of an adit and a drift. The vein pinches to a thickness of 18 inches at one end and grades into a quartz vein at the other. The primary ore is rhodonite. Pyrite, chalcopyrite, calcite, malachite, and manganese oxides are also present.

No. 2 Binet Prospect. (By Ivan F. Wilson, August 1, 1942.) A prospect owned by James T. Binet of Clipper Mills, is located in sec. 34 or 35, T. 20 N., R. 7 E. It is reached by turning off to the north from the main road about 0.5 mile west of Clipper Mills, and proceeding 1.2 miles along a side road toward Wooley's Mill. The prospect is located about 200 yards west of the road at this point. The nearest railroad is 29 miles distant at Oroville.

An outcrop of manganiferous metachert is exposed over an area of 20 by 10 feet. Manganese oxides, chiefly psilomelane, occur as thin layers, which range from a fraction of an inch to 3 inches in thickness. The metachert, gray in color, is recrystallized to fine-grained quartzite, and is cut by quartz veinlets. The beds have been mapped as belonging to the Calaveras formation.

Some individual specimens of the manganese oxides might run 40 percent manganese, but the layers are too thin for hand sorting and the rock that would have to be mined is not of shipping grade. The average grade is about 10 percent manganese. The ore may be fairly high in iron.

No. 3. Black Raven Group. (From files of U. S. Geological Survey, 1942.) A group of 40 claims, known as the Black Raven Group, in sec. 27, T. 20 N., R. 7 E., near Feather Falls is said to be controlled by William Vance. No other information is available.

No. 4. Josephson Prospect. (By Ivan F. Wilson, August 3, 1942.) The Josephson prospect lies 2 miles southeast of Yankee Hill, in sec. 10, T. 21 N., R. 4 E. It is on patented land owned by W. C. Josephson of Oroville. The prospect is in a ravine east of the Josephson ranch house and is reached by road. The nearest railroad is 18 miles to the south at Oroville. No development has been done other than superficial work on the outcrop.

The manganese ore at this prospect consists of black oxide occurring in chert enclosed in black slate or phyllite. At the main outcrop 20 feet northwest of the bottom of a ravine the following section is exposed, from southwest to northeast:

1) Black slate or phyllite.
2) 6 feet black manganese oxides; shaly and impure near the slate (apparently gradational contact); more massive to the northeast.
3) 1.5 feet of massive gray chert penetrated by small stringers of soft black oxides.
4) 4 feet of massive black oxides, becoming shaly to the northeast.
5) Hard black cherty slate.

The manganese oxide is mostly soft pyrolusite, intermingled with white silica. Individual specimens might contain 40 percent manganese, but the general run of the mine is probably closer to 30 percent. The beds strike N. 45° W., and dip 75° E. They are regarded as belonging to the Calaveras formation. The manganese ore wedges out to the southeast into the slate or phyllite. The ore body continues for 20 feet to the bottom of the ravine, where it has a thickness of only 1 foot, but it does not extend across the canyon. The extension to the northwest could not be determined because of a lack of exposure.

No. 5. Lashbough and Foley Properties. (From files of U. S. Geological Survey, 1942.) The Lashbough and Foley properties are reported to have shipped 12 tons of ore containing 50.56 percent manganese and 4.47 percent silica in July 1942. The location of the deposits is not known.

No. 6. Shamberger Prospect. (By Ivan F. Wilson, August 2, 1942.) The Shamberger prospect is about 1 mile by air line north of Clipper Mills, in the NW¼ sec. 35, T. 20 N., R. 7 E. It is on patented land owned by C. F. Shamberger of Yuba City. The prospect is in a gently sloping thickly forested area 0.2 mile south of the Shamberger cabin, east of the old Woolley sawmill. The Shamberger cabin is reached by road by proceeding 1 mile east of Clipper Mills, turning north towards Lost Creek Resort for one mile, then turning west along the road toward the Woolley sawmill for 1 mile more. The nearest railroad is 30 miles to the west at Oroville. No development has been done at the prospect.

Outcrops of manganese oxide occur in metachert. Both the manganese ore and the metachert are cut by quartz veins ranging in thickness from a fraction of an inch to 2 inches. The manganese oxides are scattered through the metachert in small stringers and irregular masses. The largest outcrop of ore is 2 feet wide and 5 feet long. It consists of very heavy black psilomelane, comparatively free of quartzite and cut by only a few small quartz veinlets. It may be rather high in iron.

The manganiferous metachert crops out over an area 20 feet in width and is seen at intervals for a distance of 200 feet, although the main outcrops are in an area 30 feet in length. The strike is roughly east, but the dip could not be determined. In most of these outcrops, the manganese oxide occurs in masses too small to be separated from the silica by hand sorting. The average grade of the manganiferous metachert is probably not more than 10 percent manganese.

The enclosing rocks were not observed in the immediate vicinity of the metachert, but in the surrounding area phyllite and sericite schist regarded as belonging to the Calaveras, crop out. A lava cap lies nearby to the east and north.

No. 7. Smithwick and Noble Deposits. (From files of U. S. Geological Survey, 1942.) According to the records of the Metals Reserve Company, 14 tons of ore containing 37.8 percent manganese and 27.2 percent silica was shipped from the Smithwick and Noble properties near Butte Meadows in 1942. No other information is available.

No. 8. Steep Hollow Claims. (By N. L. Taliaferro, September 11, 1918.) Three manganese mining claims have been located by Jackson Mullings of Enterprise and A. B. Chambers of Oroville, in the S½ sec. 21, T. 20 N., R. 7 E., about 4 miles by road and trail south of Lumpkin Post Office. These claims are on the northwest side of the south fork of the Feather River, 1,300 to 1,400 feet above the river and 3,500 to 3,600 feet above sea level. They are 35 miles from Oroville, on the Western Pacific Railroad, the nearest shipping point. A fair road runs within half a mile of the property.

Exposed along the rather steep slope above Feather River is a body of thin-bedded to massive metamorphosed red chert which can be traced almost continuously from the southwest side of Steep Hollow, a small gulch tributary to the south fork of Feather River, to the point of the ridge east of this gulch, a distance of about 0.4 mile. Because of rather deep soil, the exact width of the chert zone could not be determined but its maximum width where best exposed does not exceed 100 feet. Even here the chert is not continuously exposed for 100 feet, but apparently occurs as lenses, possibly separated by metamorphosed shales. The general trend of the zone is northwest, and it usually has a vertical dip. Northeast of the chert is dense green amphibolite containing somewhat crushed elliptical areas of quartz, which probably represent amygdules. This amphibolite is either a metamorphosed flow or a shallow intrusion. On the southwest are metamorphosed tuff and a very dense, greenish amphibolite. The contact of these rocks and the chert is parallel to the chert zone. These metamorphosed igneous and pyroclastic rocks probably represent contemporaneous flows and tuffs.

Throughout its length the chert is stained with black manganese oxide, and locally consists of a hard dense black cherty rock which seemingly contains appreciable amounts of manganese. However, not even a thin film of soft manganese oxide coats this rock, which seems to be a very intimate mixture of a manganese oxide and chalcedonic silica. The rock is cut by many veinlets of quartz and a pale pink to pinkish-lilac manganese silicate, which from its color and somewhat fibrous structure seems to be more closely related to the hydrous manganese silicates of the inesite type than to rhodonite. The oxidation of these small veins, which are less than 0.1 inch in width has produced the only soft relatively pure manganese oxide seen at any place along the chert zone.

Except for two small cuts, the deepest only 3 feet below the surface, the deposit is wholly undeveloped. In the northernmost cut, a small amount of more deeply oxidized material occurs along the southeast side of the chert zone. This material, however, contains more iron oxides than manganese.

No. 9. Sunny Park (Powell, Tade) Prospect. (By Ivan F. Wilson, August 1942.) The Sunny Park prospect, also known as the Powell property, was owned by E. F. Powell of Clipper Mills during World War I, but is now owned by the Frank Tade Estate, Driver and Driver, Trustees, Sacramento. It is in the SE¼ sec. 35, T. 20 N., R. 7 E., 1.5 miles north of Clipper Mills. It is reached by a road running north from Clipper Mills to Grizzly Lodge, a distance of 1.2 miles. The prospect is 0.2 mile north of the lodge. No work has been done on the property since World War I. A shaft about 30 feet deep is located at the prospect. This shaft exposes manganese oxides, chiefly pyrolusite, and iron oxides intermingled with fine-grained quartzite (probably metachert). The whole rock is cut by quartz veinlets. Individual specimens may contain 40 percent manganese, but the ore which would have to be mined is probably closer to 15 percent manganese. The enclosing formation is regarded as Calaveras. The ore body is not exposed on the surface around the shaft, and the dimensions could not be determined.

No. 10. View Point Property. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 30, 1918.) The View Point property consists of 160 acres in secs. 34 and 35, T. 20 N., R. 7. E. The ore body crops out for 40 feet and strikes N. 80° E. It is 1 foot wide and is developed by an open cut 3 feet wide and 6 feet long. The westernmost 20 feet of the outcrop is 20 feet wide and is siliceous. The ore presumably becomes less siliceous with depth.

Approximately 1,500 feet east of the View Point deposit and 300 feet from the road is a siliceous ledge striking north. This ledge has been opened in one place by an open cut 6 feet deep and 20 feet long, which exposes 12 inches of silica on the surface, below which is 12 inches of sugary quartz with some crystallized manganese oxide and 4 feet of manganese ore similar to that at the View Point ledge. The south end of this same ledge is within 150 feet of the road to the Bear Canyon mine. A small amount of development was done in 1918. The mine is owned by E. C. Binet of Clipper Mills.

CALAVERAS COUNTY

No. 1. Airola Mine. (By Ivan F. Wilson, September 5, 1942.) The Airola mine is southeast of Angels Camp, in the E½SW¼ of sec. 35, T. 3 N., R. 13 E. It is reached from Angels Camp by proceeding southward on State Highway 49 for 3 miles, then turning northeast along the road toward Vallecito for 1.8 miles, then turning northwest along an unimproved road for 1 mile.

The property is owned by Mrs. Emma Airola and is in the charge of Virgil Airola of San Andreas. It was leased three years ago to John T.

Martin and a considerable amount of development was done at that time. Ore was sorted and piled on several dumps at the property, but none was shipped. Since that time the property has been idle.

Several shallow workings at the Airola mine expose a number of small ore bodies. The workings are located in two main groups—one near the top of a ridge, and another 300 feet southwest on a southwest-facing slope.

The wall rocks are phyllite or sericite schist of the Calaveras formation. They are blue-gray when fresh, but weather brown. Locally thin-bedded metachert is intercalated with the schist, especially in the vicinity of the ore bodies. The chert layers are 0.2 to 0.5 inch thick, and are recrystallized to white quartzite. Partings of sericite schist, 0.2 inch thick, lie between the chert layers.

The manganese ore itself lies in massive metachert, in short, stumpy lenses enclosed in the phyllite or sericite schist. This massive metachert is now a gray to white fine-grained quartzite. Manganese oxides comprise a variable amount of the lenses of metachert. In some places they are sparsely disseminated through the metachert; elsewhere most of the lens may be composed of manganese oxides. Both the metachert and manganese oxides are cut by numerous quartz veins; some veins are 3 feet in thickness. These quartz veins trend in several directions. The manganese oxides are in the metachert but not actually within the quartz veins, except as stains. The quartz veins are predominantly but not exclusively in metachert; in one or two places they were in the surrounding phyllite or sericite schist. In the latter rock they are not accompanied by manganese oxides except for stains.

The unoxidized primary manganese minerals are pink rhodonite and garnet (presumably spessartite) which is light yellow brown when fresh, becoming dark brown to black on partial oxidation. The rhodonite and garnet were not both seen in the same specimen.

Generally the structure is simple, but locally it is complex. The phyllite and sericite schist have a general northwest strike and northeast dip, the strike ranging from N. 45°-85° W., and the dip 30°-75° NE. However, some of the ore lenses have been folded and faulted. One lens has apparently been folded into a sharp syncline, plunging steeply to the southeast. In other places sudden bends in strike occur. The schistosity of the rocks around the ore bodies nearly everywhere remains parallel to the boundaries of the metachert.

The ore bodies, as well as the enclosing schist, are cut in several places by dikes, usually 3 to 6 inches thick, but one dike is 3.5 feet thick. The dikes are composed of a highly altered, soft, crumbly, porphyritic rock weathered to a reddish or brownish color. The rock consists of decomposed feldspar phenocrysts in an aphanitic groundmass now largely altered to clay. It possibly is of andesitic composition. The thickest dike mentioned above contains biotite as well as feldspar, and has a fine-grained, holocrystalline groundmass with feldspar phenocrysts. It resembles diorite porphyry. All the dikes noticed strike northwest and dip 50°-70° SW., opposite to the general dip of the ore bodies and enclosing schists.

The dikes cut across the quartz veins as well as across the metachert and schist. However, the thickest dike mentioned above, in addition to cutting across several quartz veins which are as much as a foot thick, is itself cut by 2 or 3 narrower quartz veins 3 to 4 inches thick, which transgress both it and the surrounding rocks. This indicates at least two periods of deposition of quartz veins, the main period preceding emplacement of this particular dike, and also some deposition of quartz following the dike intrusion. The texture of this dike indicates deeper-seated conditions of formation than those of the narrower dikes of possible andesitic composition, and the latter may represent a still later period of dike intrusion.

Most of the ore available at this mine has apparently been removed and piled on various dumps. The possibilities of additional tonnage at depth are likewise unfavorable.

No. 2. Big Little Bear (Calaveras Manganese) Claim. (By Ivan F. Wilson, September 12, 1942.) The Big Little Bear claim is 7 miles by air line and 19 miles by road and trail west of Altaville in secs. 10, 11, 14, and 23, T. 3 N., R. 11 E. It is owned by Alvin Maxwell and Elmer Walker of San Andreas. It is reached by proceeding along the road from Altaville toward Milton for 14 miles to Salt Spring Valley, then turning north for 1.3 miles to Stegman's Ranch. From Stegman's Ranch a very poor road leads 3.5 miles northeast to a cabin near the top, but on the west slope of Bear Mountain Ridge. From here a trail leads a quarter of a mile southeast to the prospect, which is in a small ravine. The last 3.5 miles of the road is all but impassable, and must be improved before trucking would be possible. The nearest shipping point is 29.5 miles west, at Farmington on the Southern Pacific Railroad. The property is idle.

Three shallow pits are on the property, along a zone 150 feet in length. These pits expose a bed or series of lenses of manganese ore enclosed in thick-bedded to massive red chert. The chert is stained and somewhat penetrated by manganese oxides. It is enclosed in green metavolcanics. The beds strike N. 40° W. and dip 55° NE. They probably belong to the Amador group.

In the southernmost pit a bed of fair manganese oxide ore 1 foot thick is exposed for a length of 5 feet. About 100 feet northwest of this pit a lens of ore 3 feet thick is exposed for 10 feet. About 50 feet farther northwest a manganiferous bed 4 feet thick crops out for a length of 6 feet, and a depth of 2 feet. The ore presumably is continuous between these three places.

The manganese ore is mainly hard, blue-black brittle psilomelane, mixed with considerable chert. Neotocite may be present in the chert, and a little light brownish gray manganese carbonate was noted. Most of the material is fairly low grade, and contains much chert. The average grade is 15 to 25 percent manganese.

No. 3. Callahan Prospect. (By Ivan F. Wilson, September 9, 1942.) The Callahan prospect is 7.5 miles southeast of Milton in sec. 34, T. 2 N., R. 11 E. It is 0.2 mile from the end of a poor road. The prospect is near the bottom of a canyon in gently rolling hills on property owned by George Callahan and H. H. Donner of Milton. The nearest railroad is 23.5 miles to the west at Farmington. The property has been idle since World War I.

Development consists of an open cut 26 feet long, 4 to 5 feet wide, up to 8 feet deep, and extending due south into the hill. The cut reveals a lens of manganese ore, mainly hard, blue-black psilomelane, in gray flinty chert. The ore bed is 0.5 foot to 2 feet wide, and averages 1 foot. It is exposed in the cut and for an additional 10 feet to the south, or 35 feet altogether. The strike is north and the dip is vertical. The manganese ore and chert are enclosed in metatuff and metavolcanics. They probably belong to the Amador group. Some of the manganese oxide is fairly high-grade psilomelane, but much of it contains considerable chert. The grade is approximately 40 percent manganese.

About 1,000 feet north of the first mentioned cut are some very small pits revealing a few small blocks of low-grade psilomelane in pink to white chert. A few small patches of pink rhodonite were seen in this ore. Metatuff, metavolcanics, and minor quantities of chert are exposed between these two places.

No. 4. Carley Prospect. (By Ivan F. Wilson, September 10, 1942.) The Carley prospect is located 2.5 miles west of Murphys in the SE¼ sec. 12, T. 3 N., R. 13 E. It is on a rather steeply sloping ridge 0.3 mile south of the Carley ranch house. The nearest shipping point is 21 miles to the south, at Jamestown. The prospect is on property owned by George Carley of Murphys. A pit was dug during World War I. It is 5 feet in diameter and 3 feet deep. A tunnel was recently started below the pit but was not driven far enough to strike the ore bed. The pit reveals a bed of massive metachert containing manganese oxides and partially oxidized reddish-brown manganese garnet. The bed is cut by very narrow quartz veinlets. It is 1 foot to 4.5 feet thick and is exposed for a length of 15 feet. It wedges out to the northwest. It lies in sericite schist, belonging to the Calaveras formation. The strike is N. 65° W., and the dip is 65° NE.

The manganese oxide is low grade, consisting mainly of psilomelane, with cores and patches of limonite, and much silica. An unidentified brown, radial fibrous mineral is present. This prospect is unpromising because of the appearance of partly oxidized spessartite at shallow depth. The oxide ore derived from this is low grade, and is high in silica.

No. 5. Cave City Claim. (By Ivan F. Wilson, September 1942.) The Cave City claim is 3.5 miles southeast of Mountain Ranch in sec. 14, T. 4 N., R. 13 E. It was located in 1936 by the Thomas Brothers of Mountain Ranch. It is reached by turning off to the southeast 0.5 mile southwest of Mountain Ranch. After an additional 0.5 mile, a turn is made to the northeast. The claim is then 2.5 miles along the road toward the Thomas Brothers Ranch, beyond the former site of Cave City. The prospect is located on a fairly steep slope near the top of a ridge. The nearest shipping point is 21 miles west at Valley Spring.

The only development is a pit 4 by 3 feet, and 8 feet deep. This pit reveals mostly reddish-brown iron oxide, and a very small amount of manganese oxide, in sericite schist. The iron oxide occurs as pockets and lenses in the schist, which belong to the Calaveras formation. The material is too high in iron and too low in manganese to be used as a source of manganese. Assays of 6 to 7 percent manganese were quoted.

No. 6. Daniels (Dennis) Prospect. (By Ivan F. Wilson, September 16, 1942.) The Daniels prospect is in sec. 6, T. 2 N., R. 11 E. It is 4.2 miles east of Milton along the road to Altaville. This property was known as the Daniels prospect during World War I. It is now owned by Mrs. Minnie M. Dennis of Jenny Lind. The property is idle. Some of the workings are just north of the road, and the manganese ore bed appears in the road cut. Another set of workings starts 400 feet south of the road. The prospect is in rolling country, and the workings are mostly on a low, broad, gently sloping ridge, extending southward to an intermittent stream. The nearest shipping point is 20 miles to the west, at Farmington.

A bed of manganese ore is exposed in a series of small, shallow cuts. One group of cuts, which will be referred to as the "upper workings," extends 80 feet north of the road. The other group, the "lower workings," starts 400 feet south of the road and continues for an additional 450 feet. The total length along the workings is 930 feet, but for 400 feet south of the road there are no exposures of the manganese ore bed.

The manganese ore bed is 1 foot to 3.5 feet thick, averaging 2 feet. It is enclosed in chert—mainly thick-bedded red chert, with some white and pale green chert. The chert occurs in beds 3 to 4 inches thick without shale partings. The chert and manganese ore are enclosed in metatuff, metavolcanics, and metabreccia. Some of these rocks have a platy jointing and in the outcrop appear similar to chert. They are mostly pale green to almost white. One specimen revealed phenocrysts of long, thin, lath-shaped feldspars and quartz. The rock is possibly dacitic in composition. This belt of rocks has a general strike of N. 10°-15° W., and a dip of 60° to 75° E. It belongs to the Amador group of Taliaferro.

The manganese ore consists of manganese oxides, mostly hard, brittle psilomelane, but some soft, sooty pyrolusite is also present. The ore is low grade, and contains considerable chert. It is cut in places by narrow quartz veinlets. Partly oxidized pink rhodonite appears in several of the cuts at or not far below the surface. In one or two places heavy, brown, cherty material, which may be neotocite, was seen. The grade ranges from less than 1 to as much as 30 percent manganese. The average is 20 percent manganese. About 2 percent of iron is present.

No. 7. Fortner Ranch Prospect. (By Ivan F. Wilson, September 10, 1942.) The Fortner Ranch prospect is 3.5 miles northeast of San Andreas in sec. 4, T. 4 N., R. 12 E. It is reached by proceeding north from San Andreas on Highway 49 for 1.6 miles, then turning east for 1.8 miles. It is on the crest of a ridge 0.3 mile southeast of the road. The nearest railroad is 13.5 miles to the west, at Valley Spring. This property was located on the Fortner (or Pfortner) Ranch during World War I. It is now owned by Dorothy Ludwig of Oakland. No work has been done since World War I.

Development consists of one pit, 6 by 6 by 6 feet; a second pit, 350 feet to the northwest, 2 by 2 by 2 feet; and two additional pits 100 feet northwest of pit No. 2, one 3 by 3 feet, and 2 feet deep, and the other 2 by 2 feet, and 1 foot deep. The manganese at this property is chiefly in the form of partly oxidized brown manganese garnet, spessartite, occurring in a bed of massive metachert. The metachert has been recrystallized to fine-grained gray quartzite, and is cut by quartz veins up to 3 feet thick. At the first-mentioned pit, quartz vein material makes up the greatest part of the manganiferous metachert. The quartz veins extend into the surrounding rock, which is a quartz sericite schist. These rocks belong to the Calaveras formation. The general strike is N. 40°-55° W., and the dip is nearly vertical. The belt of metachert extends along the strike for at least 450 feet.

The garnet occurs in dodecahedral crystals. In some places the crystals make up the mass of the rock, in others they are disseminated among quartz grains. They are light brown when fresh, but are generally coated with brownish to black manganese oxide. By partial oxidation they produce a soft, crumbly brownish-black ore. The oxides include psilomelane and pyrolusite. Very little completely oxidized ore is in sight. The first mentioned pit contains a few pockets of oxide ore, the largest of which is 1 foot wide. The other pits to the northwest reveal thin crusts or small pockets of oxide ore.

No. 8. Gorham Prospect. (By N. L. Taliaferro, July 16, 1918.) The Gorham prospect, a small deposit about 50 feet long and 1.5 feet wide, is found in SE¼ sec. 18, T. 1 N., R. 13 E., 6 miles southeast of Copperopolis. The primary ore is rhodonite. Little oxide is present.

Murphys District. (By N. L. Taliaferro and Theo Crook, July 1918.) Several manganese prospects (Harrington, Hauselt, Pescia, and Zurcher) are in T. 3 N., R. 14 E., within 4 miles of Murphys, a small town 8 miles northeast of Angels Camp. Very little development work has been done on any of these deposits and no ore has been shipped. All of the deposits are small and of low grade and are of little economic importance as sources of manganese ore. The road from Murphys to the Sierra Railway at Angels Camp is in good condition, but the roads and trails from the various prospects are generally rough and steep.

All of the deposits are in schist of the Calaveras formation, and all are near the borders of the great limestone area which extends from Sonora northwest to Murphys. The presence of certain fossils (Fusulina sp.) indicates that the limestone is of Carboniferous age. No fossils have been found in the schist and slate in this vicinity, but they may be regarded as being of the same age as the limestone. The schist with which the manganese is associated is nearly all siliceous, ranging from massive quartz schist to thin-bedded quartz-sericite schist. Locally less siliceous chloritic schist is present. The more massive quartz schist occurs as lenses in the thin-bedded schist.

Usually the more massive schist has been recrystallized to finely granular aggregates of quartz, often with flakes of sericite or specks of hydrated iron oxide. In places, however, these rocks have not been thoroughly recrystallized and are made up in part of dense cryptocrystalline silica. It is probable that these are massive lenses of metamorphosed chert enclosed in thin-bedded, highly metamorphosed chert and shale.

The manganese is always associated with the more massive lenses of metachert. The massive lenses generally are merely stained or filmed with earthy black manganese oxide, but in places they form distinct lenses of siliceous oxide within the metachert. These lenses are always elongated parallel to the trend of the metachert. The lenses consist of an intimate mixture of recrystallized grains of quartz and black manganese oxide, the ratio between quartz and oxide varying between 95 percent quartz with 5 percent manganese oxide and 75 to 80 percent manganese oxide with 20 to 25 percent quartz. These lenses are usually only a fraction of an inch to a few inches in width but a few were seen which were as much as 2 feet in width and 10 to 15 feet in length.

In no place has oxidation extended to any great depth and the unoxidized material is exposed at, or a few feet below, the surface in all of the prospects. In every place this unoxidized material consists of light-brown manganese garnet. Rhodonite was found in only one prospect. Here it occurs as small grains and as minute bladed crystals associated with the manganese garnet and with quartz. The oxidation of the garnet produces a crumbly black to brownish-black ore. The grade of the ore depends, of course, on the completeness of the oxidation. In none of the prospects can material containing more than 40 to 42 percent metallic manganese be obtained and usually the grade is much lower, rarely being higher than 20 to 30 percent manganese.

In no place was there any trace of the original material from which the garnet came. In less metamorphosed deposits, manganese garnet has been found in impure, siliceous manganese carbonate. The analogy between the metamorphism of an impure limestone and an impure manganese carbonate is striking. Just as an impure limestone is metamorphosed to wollastonite and lime garnet, so is an impure manganese carbonate metamorphosed to rhodonite and manganese garnet. In both cases the nature and amount of the impurities exert a marked influence on the character of the minerals produced. It seems very possible that the garnet and rhodonite in these deposits have been derived from an impure manganese carbonate. The carbonate probably occurred both as small distinct lenses through the cherts and as small grains or patches disseminated through the chert. The manganese does not seem to have been reconcentrated by solution and redeposition. The presence of chloritic schist in the series indicates that basic tuff or flows are contemporaneous with the deposition of the sediments.

No. 9. Harrington Prospect ("Manganese Mine" Claim). (By N. L. Taliaferro, July 1918.) F. M. Harrington of Murphys has a claim near Collierville in T. 3 N., R. 13 E., 5 miles east-southeast of Murphys and 12.5 miles east-northeast of Angels Camp. This claim is leased to L. A. St. John of Stockton. The development work consists of a shaft 20 feet deep, from the bottom of which two drifts have been run, one to the west for 12 feet, and one to the east for 8 feet. The shaft pitches 70° to the north. About 8 or 10 tons of 35- to 42-percent ore have been mined but no ore has been shipped. The ore would have to be packed about 1 mile up a steep trail and then trucked to the railroad.

The ore occurs in a lens with an exposed length of 15 feet and a width of 1 foot to 3 feet. This lens is enclosed in quartz schist and is everywhere parallel to the schistosity, which is also parallel to the original bedding. Within a short distance of the surface the oxidized material passes into only partly oxidized manganese garnet. Quartz is always present. The garnet rock is usually rather coarse grained and is made up of closely packed garnets up to 0.1 inch in diameter.

No. 10. Hauselt Prospect. (By N. L. Taliaferro, 1918.) The Hauselt prospect is on land owned by John Hauselt of Murphys in T. 3 N., R. 13 E. It is 2.5 miles northeast of Murphys and 10 miles northeast of Angels Camp. No development has been done. On the slope south of Taylor Creek (a branch of Angels Creek) and at an elevation of about 3,100 feet, is an outcrop of thin-bedded to contorted and crumpled massive metachert. Here the cherty character is well shown, the more massive lenses consisting of only partly crystallized, dark-gray to grayish-black massive metachert enclosed in thin-bedded rocks of similar character. The more massive lenses are stained with manganese oxide and here and there are lenses of low-grade material. Garnet crystals, but little oxidized, may be found at the surface. These manganese-stained chert beds were traced along the ridge for more than 500 feet but no ore was seen. Even should large lenses of garnet be found, the material would be too low in grade to be of any economic importance, on account of the lack of oxidation.

No. 11. Joses Ranch Prospect. (By Ivan F. Wilson, September 10, 1942.) The Joses Ranch prospect is 1.2 miles by road northwest of Mountain Ranch, probably in the N½ sec. 5, T. 4 N., R. 13 E. The prospect is on the crest and west flank of a low ridge. It is owned by L. B. Joses of Mountain Ranch. The nearest shipping point is 20 miles west, at Valley Springs.

On the crest of the ridge, and extending to a road cut to the southeast, are exposures of thin-bedded metachert in beds 1 inch to 2 inches thick. The rock has been recrystallized to a fine-grained quartzite with original shale partings, which are ⅛ to ½ inch thick, recrystallized to sericite schist. The metachert is gray when fresh, but is stained reddish brown by iron oxide. The belt of metachert is 20 feet or more wide, and several hundred feet long. It strikes N. 35°-55° W., and dips 60° to 75° NE. It is locally greatly contorted. It is enclosed in gray sericite and quartz-sericite schist. These beds belong to the Calaveras formation.

Crusts and layers of iron oxide, and small quantities of manganese oxide occur along fractures penetrating the metachert. These contain more iron than manganese. An open cut was started down the ridge southwest of the exposures of metachert. This cut is 45 feet long, 3 feet wide and 4 feet deep. It runs N. 25° E. into the hill. It does not extend below the soil. No manganese ore is exposed at this property.

No. 12. Kellogg Mine (Vanella or Manilla Property). (By Ivan F. Wilson, September 9, 1942.) The Kellogg mine is 7 miles west of Altaville in sec. 4, T. 2 N., R. 12 E. This was known during World War I as the Vanella [1] property, or Manilla. It is reached by proceeding west along the road from Altaville toward Copperopolis for 6.5 miles, then turning north (sign points to Keeland and Gilbean Ranch) for 0.2 mile, then turning west over an unimproved road for 0.6 mile. The mine is located on the east side near the crest of the Bear Mountain Ridge. The locality of the mine may be identified from a distance by the presence of three pine trees on top of the ridge, which is mostly covered by manzanita. The nearest shipping point is 23 miles southeast, at Jamestown. The mine is owned by W. M. Kellogg of Altaville. It is leased to Wallace A. Russell of Berkeley. No one was working at the property when visited.

The main development is a T-shaped open cut. The top of the T follows the strike of an ore bed N. 30° W. and is 31 feet long, 3 to 5 feet wide, and up to 10 feet deep; this cut is joined on the east by a cut running N. 80° E. for a length of 33 feet. Another cut, 65 feet N. 30° W. from the T-shaped cut, is 35 feet long, 4 feet wide, and up to 8 feet deep. A cut, 25 feet south of the T-shaped cut, is 15 feet long, 4 feet wide, and 6 feet deep. Five hundred feet south of these cuts is another cut 20 feet long, 2 feet wide, and 5 feet deep.

The T-shaped cut reveals a bed of manganese oxide 1 foot to 6 feet thick, and averaging 2 feet, which is exposed for a length of 31 feet. The bed wedges into white chert to the southeast. The ore is enclosed in thick-bedded, white to yellowish-brown chert in beds 3 to 4 inches thick, with shaly partings. This chert is in turn enclosed in gray phyllite. The other open cuts reveal only gray phyllite or slate, except for the southernmost cut, which exposes some red chert. The strike ranges from N. 30°-35° W., and the dip from 70° NE. to 45° SW. The ore bed appears to be repeated by faulting at the north end of the cut. The beds are probably part of the Amador group.

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[1] California Min. Bur. Bull. 76, p. 31, 1918.

The manganese ore is mainly hard, brittle blue-black psilomelane. Some of the ore contains partly oxidized light brown manganese carbonate, and also brown opaline material which may be related to neotocite. The ore grades into manganiferous cherty material. It varies from nearly pure psilomelane to ore containing extensive white, flesh-pink, or pale-green cherty centers. The average grade of the ore is about 40 percent manganese.

No ore is exposed in place outside of the T-shaped cut. However, at the southernmost cut, some ore has been removed and piled on a dump. None is now in place in the bottom or sides of the cut. The ore here must have been obtained from a shallow lens which was bottomed, or else it was float ore.

No. 13. Lavagnino Prospect. (By Ivan F. Wilson, September 7, 1942.) A prospect on patented land owned by Steve Lavagnino of Angels Camp, is located 1 mile southwest of Angels Camp, in the NE¼NE¼ sec. 4, T. 2 N., R. 13 E. It is 0.3 mile south of a road going southwest from Angels Camp. It is on a fairly gentle west slope. The nearest rail shipping point is at Jamestown, 17 miles to the southeast.

One old pit 10 by 6 feet, and 3 feet deep is on the property. A few fragments of low-grade manganese ore are on the dump. This ore is mostly hard, blue-black psilomelane. Some of it, however, is fairly high grade, and some contains considerable patches of flesh-pink chert. Assays of specimens were quoted as containing 48 percent manganese. The pit itself now exposes only gray phyllite or slate, striking N. 45° W. and dipping 60° NE. A manganese bed was said to have been exposed in the pit, but this part of the pit is now caved. There are no exposures of manganese ore adjacent to the pit.

No. 14. Pescia Prospect. (By N. L. Taliaferro, July 1918.) A claim has been located by Charles Pescia of Sheep Ranch, in T. 4 N., R. 14 E., on the south side of San Antonio Creek and about 250 feet above the creek. This is 6 miles north of Murphys and 14 miles northeast of Angels Camp. Several stubby lenses of manganese-bearing metachert occur in thin-bedded quartz-sericite schist (thin-bedded metachert). Small lenses of partly oxidized quartz-manganese-garnet rock lie within the larger lenses of metachert. Oxidation has only been superficial and no good oxide ore has been developed. The prospect has no economic value as a present source of manganese.

No. 15. Soapstone Claim. (By Ivan F. Wilson, September 8, 1942.) The soapstone claim is 1 mile southwest of Sheep Ranch, probably in sec. 18, T. 4 N., R. 14 E. It is on the crest of a ridge, 0.2 mile south of the road leading southwest from the Sheep Ranch toward San Andreas and Altaville. The nearest shipping point is 26 miles west of Valley Spring. The owner is E. G. Staples of Sheep Ranch.

The only development on the claim is a pit about 4 feet in diameter and 6 feet deep. The pit is in a bed of massive gray metachert (recrystallized to fine-grained quartzite), cut by quartz veins up to 1 foot in thickness, containing pockets and lenses of partly oxidized brown manganese garnet (spessartite). The massive metachert is 2 to 4.5 feet thick and is exposed on the surface for a length of 50 feet. It is bordered by a thin zone of thin-bedded metachert, which in turn is enclosed in sericite schist. These beds belong to the Calaveras formation. The strike ranges from N. 5°-30° W., and the dip 60° to 70° E.

The garnet occurs as dodecahedral crystals which are light brown when fresh, but are generally coated dark brown to black with manganese oxide. They produce a crumbly, brownish-black, low-grade oxide ore. The garnet occurs as pockets and lenses and as individual crystals scattered through the quartz grains of the metachert. Small pockets of oxides (mainly psilomelane), derived from the garnet, occur at the surface. Assays of some of this material were quoted as 29 percent manganese and 40 percent silica.

No. 16. Sunshine Deposit. (From files of U. S. Geological Survey, 1942.) The Sunshine deposit, said to be owned by C. S. Pierce of Hughson, is located near Murphys. It has produced no ore.

No. 17. Zurcher Prospect. (By N. L. Taliaferro, July 1918.) F. D. Zurcher of Murphys has two claims in T. 4 N., R. 14 E., 3.5 miles north of Murphys and 10 miles northeast of Angels Camp. These claims are leased to L. A. St. John of Stockton. No development has been done. Manganese-stained metachert crops out at intervals for a distance of 300 to 350 feet along the strike, which is here N. 60° E. The metachert and schist are vertical. Oxidation has extended for at least 4 or 5 feet below the surface. No garnet was seen here but the crumbly brownish-black to black oxide indicates its presence. The material as a whole is low grade and is of no economic importance. Samples assaying 54 percent manganese oxide, however, are said to have been obtained here; but not more than 10 to 12 tons of such material could be obtained even by careful hand sorting.

COLUSA COUNTY

No. 1. Burgett Prospect. (By E. F. Davis, July 15, 1918.) The Burgett prospect, owned by D. W. Burgett of Lower Lake, is 4 miles west of Leesville in sec. 12, T. 15 N., R. 6 W. The property is 26 miles from Williams over fair roads. It may be reached from Williams through Leesville and along the road to Bartlett Springs to the edge of Bear Valley. The claim lies N. 52° W. from the Brimm Ranch, on the Bartlett Springs Road at the west edge of Bear Valley, and is 0.8 mile from this ranch. The manganese deposit lies on the first ridge which borders Bear Valley on the west along the line of the Bartlett Springs Road.

The work done here consists of four open cuts. The largest is near the top of the ridge on its east slope. The other three are on the west slope of the ridge. The ridge on which the manganese ore is found is composed largely of greenstone of the Franciscan group, and the areas of manganiferous rocks are surrounded by greenstone. Some of the greenstone is extremely fine grained, but a few small bodies are moderately coarsely crystallized and resemble diabase. The contacts between the igneous rock and the ore are not exposed.

At the first working place on the east slope of the ridge, a great variety of manganese-bearing rocks is encountered. An open cut 25 feet long has been made across the manganiferous beds, which strike N. 30° E., and dip 45° to 60° W. From the base upward the section exposed in the open cut consists of 3 feet of massive green chert having a granular texture, and apparently containing much crystalline quartz; 2 feet of brittle red shale containing small nodules and thin lenticular bands of red radiolarian chert; 5 feet of brittle red shale, containing much iron oxide, but without radiolarian chert; 2 feet of massive green chert with a granular texture; and 10 feet of bedded chert. This chert occurs in beds from 2 to 6 inches thick, averaging about 3 inches, and the beds are separated by thin bands of soft shaly material rich in manganese oxide.

The chert varies in its color and appearance even within the same bed. Part of it is dark to bright red with a smooth conchoidal fracture. This chert contains large numbers of small round spots of clear chalcedony and is unquestionably a radiolarian chert. It is cut by minute fractures and along these the red color has been removed, leaving a network of little streaks of blue-gray to green color, surrounding cores of unchanged red chert. At other places the red chert passes gradually into a white to cream-colored chert, sometimes a blue-gray chert, cut by many minute veinlets of black manganese oxide.

Another variety of chert which is found here is dark but intensely green in color, with a smooth conchoidal fracture and a waxy luster. This green chert undergoes an alteration along bedding planes and joint cracks. The change apparently consists of the leaching of some constituent from the green chert, as along open spaces the chert passes into a white porous skeleton of silica. The substances removed are probably iron and manganese, because at the places where the green chert has been altered are heavy coatings of oxides of these metals.

Above the open cut are outcrops of massive manganiferous chert which are thicker than any of the beds of massive chert exposed in the cut below. Apparently the beds are lenticular and the iron-rich shale at the base of the section decreases in thickness as the massive chert increases correspondingly in thickness. Some work has been done in making an open cut. A great variety of manganiferous siliceous rocks is present.

All of these rocks contain considerable amounts of manganese, and on exposure to air they become coated with black oxides of that metal. A considerable part of the rock is minutely granular in texture and on fracture surfaces shows numerous bright points of light. Apparently rocks of this type contain much crystalline quartz. They are of several colors—bright green, dark green, yellow, yellow-brown, brown, pink, and red. Many specimens are found which show variegated colors.

Another kind of rock shows a smooth conchoidal fracture and is apparently a mixture of iron and manganese oxides with chalcedonic silica. Most of these rocks contain considerable manganese and become covered with a black coating on exposure to the atmosphere. In color they vary greatly according to the relative state of oxidation and the relative proportion of iron and manganese oxides. Some are white, yellow, brown, or red, and some are greenish. The red varieties of this type are the red radiolarian chert mentioned above. They consist of chalcedony stained by grains of ferric oxide. In the yellowish and yellow-brown varieties it seems probable that the dominant color is limonitic iron oxide.

Some of the reddish-brown varieties are of the same appearance and physical properties as material found at many other deposits in the Coast Ranges and consist of an intimate mixture of manganese oxides and chalcedonic silica. On exposure to the air the lower oxide of manganese passes into the higher oxide and the material becomes a black, rather siliceous oxide of manganese. The greenish varieties may be an intimate mixture of chalcedonic silica with ferrous compounds and with manganese in the lower state of oxidation. When exposed to surface weathering, this material gives a mixture of black manganese oxide and iron oxide containing leached cores of porous silica.

Another type of material is soft, extremely brittle, with a smooth conchoidal fracture and a waxy luster. It crushes easily to a fine powder. This material is an intimate mixture of iron and manganese oxides and opal. The varieties are bright red to dark red, reddish brown, dark brown, or black in color. The color differences are apparently governed by the state of oxidation and the relative amount of the manganese and iron which they contain. The red and black varieties are little altered on exposure to the action of the weather, but the brownish varieties quickly become covered with a coating of manganese oxide.

In addition to the lithologic types mentioned above, are thicker beds and thin partings of iron-rich shale and siliceous iron oxide or paint rock.

All of these lithologic types are interbedded with one another and with the soft red shale in a way which indicates that they are contemporaneous in origin. The presence of the radiolaria in the red chert demonstrates that these manganiferous rocks are marine sediments.

Under the action of weathering and surface oxidation the manganese passes into the form of the higher-grade black oxides, and black manganese ore results. Such ore is usually siliceous, the quality depending upon the amount of silica present in the primary mixture. Locally a pocket of high-grade black oxide is found, but the amount of this is small. It seems certain that some of the high assay values reported from this property were obtained from samples of this material. Much of the rock here is better referred to as manganiferous chert than manganese ore.

The outcrops of the manganiferous rocks may be traced for 50 feet on the surface. Though the amount of material is large, most of it is too high in silica and too low in manganese to be of value as a source of manganese, even if concentration were possible by chemical or other means. Probably 200 tons of moderately siliceous ore, estimated to run 25 to 30 percent silica and 35 percent manganese, could be obtained here.

On the west side of the ridge is a second working place. It is probably located on the same horizon as the first. On the top of the ridge and on the west slope are outcrops of massive red chert, between the two points where manganiferous rocks are exposed. A belt of chert extends through the greenstone across the top of the ridge. Here an open cut has been run into the hill for a short distance. It exposes red radiolarian chert heavily stained along fissures and parting planes with black manganese oxide. Nothing of commercial importance was seen here.

Fifty feet from the second working place and lower down on the same horizon in the radiolarian cherts is another open cut. The radiolarian chert here strikes N. 20° E., and dips 80° W. On the footwall side greenstone is exposed. The chert shows no sign of disturbance or alteration due to this igneous rock and appears to rest on it with normal sedimentary contact.

At the base are 2 feet of fine-grained bright green shale containing a few nodules of dark gray radiolarian chert. Above this are 2 feet of brittle, thin-bedded, cream-colored chert with red shale partings. These are followed by 8 feet of rather massive chert showing a few thin red shale partings. At the top of the section is 1 foot of thin-bedded brittle cream-colored chert. The 8-foot zone of rather massive chert consists in part of red radiolarian chert, but mostly of dark green chert which, when oxidized, yields oxides of manganese and iron and patches of white porous silica. Nothing likely to be of commercial importance was seen here.

Some 150 feet south of the third working place and near the crest of the ridge on its west slope is a fourth working place. This is at a different horizon. Here a small open cut exposes greenish chert mixed with oxides of manganese and iron, containing cores and patches of porous silica. A small amount of red radiolarian chert is in this opening. No material likely to have commercial importance was exposed in this place.

No. 2. Gullman Deposit. (By Spangler Ricker, 1942.) The Gullman deposit is in secs. 1, 2, and 12, T. 15 N., R. 6 W., about 25 miles west of Colusa and 1 mile off the road. The deposit is owned by Arthur Gullman. The strike is N. 30° E., and the dip is 75° W. The ore body is exposed for 300 feet and is 4.5 feet wide. The grade ranges from 3 to 30 percent manganese and 6 to 10 percent iron. It is high in silica. No ore has been shipped.

No. 3. Rathburn Prospect. (Modified slightly from original description in California Min. Bur. Bull. 38, p. 335, 1906.) Manganese was prospected about 1890 by J. P. Rathburn of College City, in sec. 4, T. 17 N., R. 7 W. The deposit was afterwards abandoned.

CONTRA COSTA COUNTY

Red Rock Deposit. (By A. C. Lawson, 1914. Modified slightly from original description in San Francisco Folio, p. 23, 1914.) Manganese occurs on Red Rock, in T. 1 N., R. 5 W., in San Francisco Bay, just off the Contra Costa coast, and included within the county limits. The ore occurs as an integral part of the radiolarian chert on the southwest side of the island. The chert here has a west-northwest strike and a nearly vertical dip, and consists of rhythmical alternations of thin beds of hard, flinty to quartzose chert and partings of shale, the whole having a reddish color. A belt parallel to the strike of the chert includes interstratified layers of psilomelane, which, by reason of their black color, present a bold contrast to the adjoining rocks. Most of the layers are 0.2 to 0.5 inch thick and locally replace the usual shale parting, but in places the psilomelane is much thicker. Some of the layers of the chert adjoining these layers of psilomelane are also so charged with the mineral that they are quite black, though they are still hard and siliceous. The psilomelane also occurs in minute particles in the shale between the chert beds, making it black. The borders of the belt in which these layers of psilomelane occur are not sharply defined, but the mineral has been mined in open cuts 2 to 6 feet wide. The ore appears to be essentially a primary deposit, contemporaneous with the deposition of the silica that formed the chert, although doubtless some of the psilomelane has since migrated into adjoining beds.

The shale partings north of the manganese outcrop on Red Rock are abnormally thick, generally measuring from 0.5 inch to 2 inches, and at some places the shale is 1 foot to 2 feet thick. It has a soft, earthy consistency, and a shale structure. It is prevailingly red, though the color grades locally into yellow. This shale was at one time mined as mineral paint.

DEL NORTE COUNTY

No. 1. Siskiyou Fork Trail Deposit. (By Spangler Ricker, 1942.) The Siskiyou Fork Trail deposit is in sec. 11, T. 17 N., R. 3 E., about 30 miles from the railroad. It consists of films of manganese on schist.

No. 2. Stone Deposit. (By Spangler Ricker, 1942.) The Stone deposit is said to be located in sec. 35, T. 18 N., R. 1 E., about 17 miles from the railroad. It consists of manganiferous chert and is of low grade.

EL DORADO COUNTY

No. 1. Alderson Deposit. (By N. L. Taliaferro, 1918, and Ivan F. Wilson, August 18, 1942.) The Alderson manganese deposit is unusual in being of Tertiary age. It occurs in El Dorado County, 1.5 miles southeast of Placerville in secs. 16 and 17, T. 10 N., R. 11 E. The owner is Mrs. Agnes Alderson. No development had been done and the deposit was poorly exposed, being largely covered with soil and hill wash. Along the south slope of a lava capped ridge, outcrops of arkosic sandstone cemented by black manganese oxide may be traced for a distance of 150 feet. This sandstone occurs in flat-lying Tertiary volcanics and is interbedded with rhyolite tuff below and an andesitic agglomerate above. The black oxide matrix makes up an appreciable part of the rock, assays of this material giving as high as 25.9 percent metallic manganese. Under the microscope the rock is seen to consist of rounded sub-angular grains of quartz, orthoclase, a little oligoclase, and a few flakes of mica in a matrix of black manganese oxide.

The original form of the manganese is not known. It may have been originally deposited as the carbonate or as the oxide. The volcanics with which it is associated are known to have been poured out on land, and since it is quite probable that the sandstone was laid down in contact with air or in oxygenated stream waters, it seems more reasonable to suppose that the manganese was originally deposited as the oxide. The origin of the manganese is purely a matter of speculation, but since it is so closely associated with volcanic rocks it may have been derived from the leaching of manganese-bearing tuffs or flows, or it may have come from a local manganiferous spring having its source in the volcanics.

That the manganese was not introduced after the deposition of the sandstone is proved by the fact that in areas in which the black oxide matrix is abundant the isolated grains are not in contact with each other and show no sign of replacement.

No. 2. Buffalo Bill Deposit. (By Spangler Ricker, 1942.) The Buffalo Bill deposit is in sec. 10, T. 12 N., R. 10 E., about 12 miles from the railroad. It consists of low-grade oxide in metasedimentary rocks. One assay ran 11.7 percent manganese. The quantity of ore present is small and the deposit is not promising.

No. 3. David Prospect. (By Ivan F. Wilson, August 16, 1942.) The David prospect is west of Georgetown in sec. 10, T. 12 N., R. 10 E. It is reached by road west from Georgetown toward Greenwood and Auburn; 0.6 mile along this road an old road turns off to the north, underneath a flume. About 0.1 mile along this road another flume lies to the west, and a camp site may be seen along the road. The prospects are in dense brush about 100 feet east of this point. The nearest railroad is at Placerville, 16.5 miles to the south. The prospect is owned by D. David of San Francisco.

Development consists of two cuts and a few small pits. One cut is 28 feet long, 6 feet wide, and 6 feet deep. It trends N. 20° E. along fairly level ground. Forty feet south is another cut trending N. 10° E. It is 30 feet long, 5 to 6 feet deep, and ranges in width from 10 feet at the north end to 15 feet at the south end. Between the two cuts is a series of smaller shallow pits. The best exposures are on the south face of the southern cut, where siliceous ore crops out. This ore is exposed for a depth of 2 feet, below 3 feet of overburden. The rock here is a white chert, to some extent recrystallized to a very fine-grained quartzite. The chert is penetrated by manganese oxides in stringers usually not over 1 inch thick. The major bands of manganese oxides run more or less parallel to the bedding of the chert, but others cross the bedding at various angles. The oxides are probably psilomelane and pyrolusite, mixed with some limonite. Presumably very little of the material would run over 20 percent manganese, and most of it would probably average 5 to 10 percent. The best material is in a 1-foot zone at the west end of the exposure, but even this is so mixed with the chert that it would probably not run over 20 percent manganese. The chert strikes N. 10° E., and dips 60° E. Sericite schist is exposed on the west wall of the northern cut, striking N. 10° E., and dipping 70° E. Rocks exposed in the surrounding area are likewise sericite schist.

No. 4. Double E Claim. (By N. L. Taliaferro, August 1918.) The Double E Claim is in sec. 12, T. 9 N., R. 10 E., 4 miles south of El Dorado near Diamond Springs. The deposit is small and low in grade.

No. 5. Martinez Gold Mine. (By Ivan F. Wilson, August 17, 1942.) Two small undeveloped manganese prospects are on the property of the Martinez gold mine, 5 miles southeast of El Dorado, in the NE$\frac{1}{4}$ sec. 13, T. 9 N., R. 10 E. The owner is the Martinez Gold Mine Company, of El Dorado. El Dorado is on the Placerville branch of the Southern Pacific Railroad. The prospects are within 0.2 mile of the road to the mine.

At one point a manganiferous lens is exposed with a length of 10 feet and thickness of 2 feet. The deposit contains pink rhodonite which has been partly altered to black oxides. The lens is cut by numerous quartz veins 3 to 6 inches thick. These alone make up a considerable proportion of the ore body, and would be difficult to separate from the manganese. The material in sight is too high in silica to be mined, possibly running 20 to 30 percent manganese. The lens is immediately bordered by a thin zone of cherty slate, which in turn is enclosed in sericite schist (probably of the Calaveras formation). The lens and enclosing schist strike N. 5° E., and dip 60° W. The beds have slumped due to hill creep.

A smaller lens is exposed farther down the hill to the southeast. It is 5 feet long, 2 feet wide, and 4 feet deep. The lens has been exposed with a pick so that it can be seen to wedge out rather abruptly into the enclosing sericite schist at each end and at the bottom. The schist here also strikes N. 5° E., and dips 60° W. The lens consists of impure manganese and iron oxides, cut by quartz veins.

No. 6. Mocettini Prospect. (By Ivan F. Wilson, August 30, 1942.) A prospect owned by Philip Mocettini of Shingle, is said to be in sec. 13, T. 8 N., R. 9 E. It is reached by proceeding along the road north of Latrobe for 1.4 miles, then turning southeast for 2.2 miles, then north through a gate, and continuing for an additional quarter of a mile. The second road mentioned crosses the Placerville branch of the Southern Pacific Railroad at Flonellis Siding, about 2 miles from the prospect.

A cut 10 feet long, 6 feet wide, and 6 feet deep, exposes greenstone, rather heavily stained with manganese and iron oxides. The manganese content is probably not over 5 percent. The greenstone is enclosed in gray phyllite or sericite schist striking N. 20° E., and dipping 80° E. The greenstone is cut by a quartz vein 4 inches thick.

The films of manganese oxide on the fractures in the greenstone give a misleading notion of the nature of the rock to the prospector; but upon breaking the rock open the manganese is seen to form only a thin veneer.

FRESNO COUNTY

No. 1. Avery Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 32, 1918.) The Avery manganese property is in T. 21 S., R. 14 E., 9 miles from Coalinga on the road to Paso Robles. An assay of surface ore is said to have run 45 percent manganese and 20 percent silica. No development work has been done. The property is owned by George D. Avery of Porterville, Tulare County.

No. 2. Crisle Prospect. (By N. L. Taliaferro, June 8, 1918.) The Crisle prospect is in sec. 15, T. 12 S., R. 24 E., on land owned by John Crisle of Sanger. The nearest shipping point is Piedra, 9 miles by road southwest of the prospect. The roads to Piedra are steep and rough and badly cut by the chrome trucks. In building a sled road from the Black Joe, Lookout, and Valley View chrome mines a small body of rhodonite rock was discovered. A 5-foot pit was sunk, but as no commercial ore was found, the prospect was abandoned.

The enclosing rocks are thin-bedded metachert and metamorphosed siliceous shale. A few beds of massive red metachert are present but no manganese was found with these more massive beds which represent a series of dynamically metamorphosed chert, shale, and tuff. They have been intruded by masses of basic igneous rocks, such as dunite and pyroxenite, but there is no evidence of contact action. The rocks at this prospect are much less metamorphosed than the schist referred to the Calaveras formation which occurs in a belt a few miles to the east. Even where the Calaveras has been only dynamically metamorphosed without any visible contact action, it is extremely schistose, and it is difficult to determine the original character of the rocks. There is little doubt, however, as to the original character of the rocks exposed in the vicinity of the Crisle prospect. The original bedding is clearly shown by the alternations of thin and thick beds of chert and the thin-bedded chert and shale. The chert has been crystallized to a certain extent and frequently shows a fine sugary texture. The more massive chert has been less crystallized than the thin-bedded chert and is largely composed of chalcedonic silica and red iron oxide.

Interbedded with the thin-bedded chert and shale are lenses and beds of dense rhodonite and quartz-rhodonite rock as much as 6 inches in width. This is a very dense aphanitic pink rock, and no definite crystals of rhodonite can be seen with the hand lens. The rock has been partly oxidized to black manganese oxides. The first product of oxidation is granular siliceous black oxide. This passes into a glossy, lustrous black oxide which has the physical appearance of beldongrite, a mineral described by Fermor[1] to which he assigns the formula $6Mn_3O_5.Fe_2O_3.8H_2O$.

No. 3. Harper Prospect. (By N. L. Taliaferro, June 11, 1918.) The Harper Prospect is in the NW¼ sec. 33, T. 11 S., R. 24 E., on land owned by W. J. Harper of Watts Valley. It is in Watts Valley 1 mile west of Watts Valley Post Office and 25 miles northeast of Clovis, on the Southern Pacific Railroad.

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[1] Fermor, L. L., The manganese ore deposits of India: India Geol. Survey Mem., vol. 36, p. 115, 1909.

The rocks in this vicinity consist of highly metamorphosed quartz schist, quartz-sericite schist, quartz-biotite schist, and crystalline limestone intruded by granite, granodiorite, and dikes of aplite. The metamorphosed sediments are best exposed on a hill or short ridge 0.3 mile north of the county road. On the east end of the ridge the schist strikes N. 75°-80° W., while on the west end the strike is N. 50°-60° E. This difference in strike is probably due to the granite body which is exposed near the western end of the ridge. The dip is vertical. That the schistosity and the original bedding are essentially parallel is indicated by the fact that the bedding on the crystalline limestone is parallel to the schistosity. This limestone ranges up to 10 feet in width and can be traced for several hundred feet. The schist zone south of the crystalline limestone was evidently originally limy as it contains areas of calcite. Across the strike to the south the schist becomes more and more siliceous until the beds are composed wholly of quartz. Associated with these pure quartz rocks are lenses of rhodonite or quartz-rhodonite rock. These rhodonite lenses occur in a zone at one definite horizon and can be traced for 200 yards along the strike, practically as far as the schist is exposed. Both to the east and west the schist is covered with soil and valley alluvium.

These lenses are small, usually only 8 to 10 inches in width, but in one or two places they are as much as 18 to 20 inches wide. All the rocks of this series become coarse grained as the granite contact is approached. The crystalline limestone is filled with patches of tremolite or wollastonite. The quartz schist becomes coarser, and the schistosity is less well marked. The rocks cannot be traced directly to the granite contact, because of the covering of soil and alluvium. However, near the contact, the limestone has been converted into a garnet-vesuvianite rock; the rhodonite-quartz rock becomes very coarse grained and crystals of manganese garnet up to 0.1 inch in diameter are developed. A 40-foot shaft has been sunk near the contact. Here coarsely crystalline rhodonite-quartz-spessartite rock enclosed in a coarse-grained quartz-mica schist is exposed.

Oxidation has taken place at the surface and along the cracks, but no commercial oxide ore has been formed. The rhodonite rock usually contains considerable quartz. There are no indications of ore of commercial value.

No. 4. McMurty Prospect. (By Ivan F. Wilson, September 27, 1942.) The McMurty prospect is 1 mile west of Watts Valley in sec. 33, T. 11 S., R. 24 E., on land owned by W. F. McMurty of Watts Valley. The nearest shipping point is 18 miles to the southwest, at Piedra on the Santa Fe Railroad. No development has been done since World War I, and no further work on the property is contemplated by the owner.

Two caved shafts are on the prospect, one 10 feet deep, the other 4 feet deep. Both are so filled with debris, that no bedrock can be seen. The dumps reveal a few fragments of a rhodonite-quartz rock (probably a metachert) cut by quartz veins. The rhodonite is partly oxidized to pyrolusite and psilomelane, but no large amount of oxide ore is developed. The ore is low grade, probably 10 to 20 percent manganese. The rhodonite itself is low grade, being mixed with quartz. In the vicinity are exposures of quartz-biotite schist, very rich in quartz. This prospect has no probable economic value.

No. 5. Price Prospect. (By N. L.Taliaferro, June 1, 1918.) The Price prospect is owned by J. W. Price of Trimmer. It is in sec. 11, T. 12

S., R. 24 E., 3 miles northwest of Trimmer and 12 miles northeast of Piedra, the nearest shipping point. It is 1 mile by trail from the old Trimmer-Watts Valley road. The road to Piedra is rough, and in places, very steep.

The rocks in the vicinity are deeply weathered and are not well exposed. They seem to be predominantly quartz-sericite schist and quartz-chlorite schist, and are provisionally referred to the Calaveras formation. The ore occurs in both types of schist. The ore bodies are fairly well defined, and they definitely follow the schistosity of the enclosing rocks.

The ore consists of a dusty black manganese oxide, which is found between the quartz grains and occasionally as a coating on the grains. The ore as a whole is very friable and crumbles readily.

The origin of the oxide is not clear, but in certain other deposits in which a similar material occurs, the oxide is formed by the oxidation of manganese garnet.

No. 6. Sunset and Sunrise Deposit. From files of U. S. Geological Survey, 1918.) The Sunset and Sunrise deposit owned by V. R. Smith is reported to have produced 33 tons in 1917 averaging 43 percent manganese and 23 percent silica. The location is unknown, but is said to be in the Alcalde district.

No. 7. Trewick-Houghton Prospect. (By N. L. Taliaferro, June 6, 1918.) The Trewick-Houghton prospect is on land owned by C. C. Trewick of Dunlap and is leased by J. B. and R. J. Houghton of Dunlap. It is on a wagon road in the SW¼ sec. 29, T. 13 S., R. 26 E., and is 0.3 mile north of the Squaw-Valley-Dunlap road. It is 4 miles northwest of Dunlap and 27.5 miles east of Sanger, the nearest railroad point.

The rocks exposed in the region consist of highly metamorphosed schist belonging to the Calaveras formation. These rocks have been strongly folded and compressed, and they have been intruded by granite and granodiorite. They may be described as quartzite, quartz schist, and quartz mica schist. In this quartzose series and about 0.3 mile from the nearest exposed granite, partly oxidized rhodonite occurs, more or less intimately associated with quartz, in places over a distance of 100 to 150 feet along the strike of the schistosity. As may be seen from a few more massive beds of quartzite, the schistosity and original bedding practically coincide. No development has been done and the rhodonite rock is not well exposed, but from the occasional outcrops, this rock apparently has no definite walls, and grades into the schist. In fact, the rhodonite-quartz rock differs little from the quartz schist except for the presence of rhodonite. This rhodonite-quartz rock is fine to medium grained. A few small areas of almost pure rhodonite and quartz in about equal proportions are found. There are also a few secondary veins of rhodonite and quartz, but these do not extend beyond the limits of the quartz-rhodonite schist.

The more massive ''quartzite'' is peculiar, in that it is an extremely pure quartz rock made up of fine granular quartz. Originally it could have been one of two things, an exceedingly fine grained pure quartz sandstone, or a chert. The latter seems the more probable. Although definite evidence is lacking, these rocks may have originally been a series of chert and siliceous shale with lenses of manganese ore. The original nature of the manganese cannot, of course, be discovered. Whatever its nature, it has been wholly converted to rhodonite by dynamic and contact metamorphism. The manganese does not seem to be due to the granite intrusion. The ore is found at some distance from the contact and there is no indication of veining or replacement.

The rhodonite is only slightly oxidized. Crusts of siliceous oxide ore up to 0.7 inch in thickness are found, but as a rule only thin films of oxide coat the rhodonite rock. There has been no past production and on account of the very siliceous character and lack of oxide ore the chance of future production is poor.

No. 8. Woods Property. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 32, 1918.) The Woods manganese property is in T. 12 S., R. 24 E., on government land on Pine Flat near Piedra. The ore is said to carry 26 percent manganese and $4.00 per ton in gold. The manganese is probably superficial. It is owned by ''Jake'' Rice of Pine Flat.

GLENN COUNTY

No. 1. Big Stony Creek (Rockridge) Mine. (By Ivan F. Wilson, July 20, 1942.) The Big Stony Creek or Rockridge mine is located about 1 mile north of the diversion dam on Big Stony Creek. It is close to the line between secs. 25 and 26, T. 18 N., R. 7 W., and is near the boundary between Glenn and Colusa Counties. It is on the crest of a narrow ridge running down to the south, at an elevation of 1,600 feet. This ridge and the surrounding slopes are covered by a thick growth of chamiso. A trail has been cut through this chamiso to the prospect, leaving Big Stony Creek at a point 0.3 mile east of the Division Dam. The dam is 3 miles west of Stonyford, and the total distance by road from Fruto on the Southern Pacific is 27 miles. The deposit is owned by E. J. Hansen of San Francisco.

An open cut about 30 feet long has been run into the hill in the direction of N. 40° E. The upper end of the cut reveals a bed of massive red to yellow-brown chert 8 feet thick. The chert strikes N. 30° W., and dips 30° NE. It is underlain by thick, irregularly-bedded red chert with brown, nodular, manganese stained surfaces. The massive chert is overlain also by thick-bedded red chert. Both the upper and lower contacts of the massive chert are sheared. The manganese ore occurs as narrow pockets in the massive chert. These pockets range in size from a fraction of an inch to a few feet; the biggest mass seen was a foot wide and 3 feet long, and included some chert. The ore consists of black oxides, chiefly psilomelane. Some of the material shows a distinct conchoidal fracture and may represent neotocite coated with black oxides. Shaly black oxide ore an inch or two thick is exposed in one place above the massive chert and below the overlying red chert. Most of the ore is rather cherty. Individual small specimens might run 45 percent manganese, but it is doubtful that there is any quantity of this material.

The massive chert is exposed for a length of 50 feet. About 150 feet up the ridge to the north, another massive chert is encountered. This chert contains manganese stains, but no bodies of ore were seen. The two massive chert bodies are separated by thick-bedded red chert possessing brown, nodular, manganese-stained surfaces. About 300 feet north of the open cut is exposed a thick-bedded white chert, which strikes N. 20° E., and dips 55° SE. Along the trail from Big Stony Creek there is much float of red chert, some with manganese stains. Other exposures are sandstone and greenstone.

No. 2. Black Diamond Mine. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 32, 1918.) The Black Diamond mine, embracing two claims, is in secs. 14 and 23, T. 18 N., R. 7 W. Fruta, 30 miles to the southwest, is the nearest shipping point, and is reached by a good auto road. A body of manganese ore was struck in driving a tunnel on a copper prospect. It was at first thought to be very extensive, as a width of 40 feet was exposed. On being stoped, however, it pinched down to a narrow stringer, yielding only about 100 tons of good ore. The ore was shipped in 1917 by A. H. Noyes of San Francisco who has a lease on the property. Although located about 1900 this was the first ore produced. Work ceased when the lens pinched down. The ore body does not crop out. The owners are A. W. Sehorn, et al., of Willows.

No. 3. Brown & Moore Prospect. (By Ivan F. Wilson, July 15, 1942.) A long open cut has been constructed on the hill slope 0.3 mile southeast of the K. B. 4 claim (Glenn 8), at an altitude of 1,800 feet. It is in the N ½ sec. 1, T. 18 N., R. 7 W. The nearest road is at the K. B. 4 claim, which is 25.5 miles from Fruto. The prospect is on the Brown and Moore Ranch of Stonyford.

An open cut 300 feet long and averaging 14 feet wide has been constructed with a bulldozer. This cut trends to the east along a steep hill slope, more or less following the contour of the slope. The cut reveals a belt of manganiferous chert 2 to 10 feet wide, containing a very small amount of siliceous manganese ore. The chert follows the direction of the cut, striking from N. 80° E. to N. 80° W., and dipping 45° to 65° S. This chert is rather splintery and shaly, and is buff, greenish, and white. It is stained and somewhat penetrated by manganese oxides. It probably would not run over 5 to 10 percent manganese. It contains occasional pockets of siliceous black oxide (pyrolusite and psilomelane) which might run 35 percent manganese. The largest fragment of ore seen was 2 feet in maximum dimension.

The manganiferous chert is overlain by sandstone. It is underlain by well-bedded green chert, which appears in the north part of the cut. Down the slope to the north end of the cut, red chert fragments are seen, although this red chert was not found in place. The red chert is bordered by a rather thick belt of sandstone, which separates it from the much thicker chert body comprising the K. B. 4 claim (Glenn 8) to the north.

Very little material exposed here should be called ore. Since the cut discloses the manganiferous chert body rather well, there is little hope that an ore body might be found.

No. 4. B.S. No. 1. (By Ivan F. Wilson, July 17, 1942.) The B. S. No. 1 claim is located 0.5 mile south of Alder Springs, in sec. 26, T. 21 N., R. 8 W. It lies along the road running south from Alder Springs toward Alder Flat. The workings occur within a switchback on this road, as it switches from east to west, going down toward the south. The claim is on the south slope of a long, high east-trending ridge between Rattlesnake Creek and Salt Creek. The claim is at an altitude of 4,000 feet. The nearest shipping point is Fruto, 24 miles to the east by good road. The claim was located on government land April 27, 1941, by W. E. Sale and Charles A. Butler of Elk Creek. The long direction of the claim is northwest.

This prospect, although probably of no commercial value, is of interest in that it does not occur in the Franciscan group. It is in a thick belt of schist, which is exposed along the road to Alder Springs for at least 8 miles and also along the road south of Salt Creek for an equal distance. The western boundary of this schist belt was not encountered, and it may be a considerable distance beyond Alder Springs. To the east the schist is bordered by a belt of serpentine, which in turn is bordered by shale of the Knoxville formation, but the nature of the contacts was not determined. The rocks in this schist belt are predominantly slaty, yellow to yellowish green sericite schist, or slaty schist, seemingly derived from shale. A few beds of course-grained dark-gray quartz-biotite schist have developed from sandstone.

The schist shows a nearly constant grade of metamorphism over a wide area, whereas metamorphism in the Franciscan is generally spotty and localized. The schist was developed chiefly from shale, probably more than 90 percent being so derived. While shale is not uncommon in the Franciscan, there is no area as large as this known to the writer in which shale predominates, sandstone usually being the prevailing rock. None of the more typical rocks of the Franciscan group, such as radiolarian chert and greenstone, were observed in the schist belt. The schist is lithologically similar to the schist occurring on South Fork Mountain in Trinity County and may represent the same group of rocks. The age of this schist is unknown, other than that it is pre-Franciscan. It may be pre-Cambrian.

The manganiferous material occurs as a bed 3.5 feet wide enclosed in schist. The bed on fresh exposure is seen to be dark green to nearly black, hard, dense, and massive. It should probably be described as a slaty chert or cherty slate. Some specimens reveal a faint banding and parting parallel to the bedding. The manganese, consisting chiefly of psilomelane, but with some pyrolusite, occurs as films and veinlets as much as 0.1 inch thick along the fractures, and to some extent penetrating the rock. Some of the veinlets have a porous or scoriaceous appearance. Unbroken specimens are deceptive in that they may be entirely coated by manganese oxides, but freshly broken specimens reveal that the main mass of rock is the dark green slaty chert described above, cut by veinlets of the manganese oxides. It is estimated that the bed averages less than 10 percent manganese.

The manganiferous bed is overlain by yellow-green sericite schist similar to that making up the majority of the schist belt previously described. It is underlain by a bed of dark-gray schistose sandstone 10 feet thick, which in turn is underlain by sericite schist similar to that above. The manganiferous bed strikes N. 20° E. and dips 35° W. Its attitude is essentially parallel to the schistosity of the enclosing schist, although the attitude of the latter is locally variable.

Development consists of a tunnel 10 feet long driven along the manganiferous bed, and open cuts along the bed above the tunnel. The bed is exposed along the road cut on the north side of the switchback. It is exposed for a total length of 175 feet. The grade of this manganiferous bed is about 10 percent manganese, which is too low to be of economic value.

No. 5. Elephant Hill Prospect. (From files of U. S. Geological Survey, 1942.) The Elephant Hill prospect owned by Charles and Vesta

Keller is located in T. 19 N., R. 7 W., about 25 miles from the railroad. No other information is available.

No. 6. Hummingbird Claim. (By Ivan F. Wilson, July 17, 1942.) The Hummingbird claim is located along the road from Alder Springs to Elk Creek via Alder Flat, in sec. 36, T. 21 N., R. 7 W. According to the locators it is 198 feet south of B. M. H247 at 1,413 feet altitude, and is 1 mile west of the mouth of Hummingbird Canyon. It was located June 24, 1941, by Lloyd D. Stall, H. A. Butler, and Raymond Butler of Elk Creek. The long direction of the claim is north. The claim is 5 miles west of Elk Creek and is 11 miles west of the nearest shipping point, at Fruto.

This deposit is of the same general type and is in the same belt of schist as the B. S. No. 1 claim (Glenn 4) to which the reader is referred for a description of the general geology. The manganiferous bed at this prospect is 2 to 4 feet wide. It is a slaty chert or cherty slate similar in appearance to that at the B. S. No. 1; that is, it is dark green to nearly black on fresh exposure, hard, dense, and massive. It is covered with films and cut by veinlets, up to 0.1 inch thick, of manganese oxides. It is also cut by quartz veinlets up to 0.3 inch thick. The grade is about 10 percent manganese.

The bed strikes N. 55° E., and dips 50° NW. It is overlain by a gray schistose sandstone with a similar attitude. It is in contact to the southeast with a yellowish-green sericite schist, but this contact is apparently a fault, as the schist is nearly vertical, and the manganiferous bed appears to be cut out toward the southwest. The bed is exposed in an open cut, for a length of 10 feet. Its extent beyond this point is not known.

No. 7. K.B. No. 1 Claim. (By Ivan F. Wilson, July 14, 1942.) The K.B. No. 1 claim, first of four claims in the K.B. group, is in the S½ sec. 35, T. 19 N., R. 7 W. It is on the south slope of Elephant Hill at an altitude of 2,400 feet and is 1,000 feet north of a spring on the trail south of Elephant Hill. The nearest road is at the K.B. No. 4 claim (Glenn 8), 1 mile southeast. From here it is 4.7 miles by a poor road to the Brown and Moore Ranch, then 21 miles by good road via Elk Creek to the nearest shipping point, at Fruto.

The K.B. group was surveyed by August J. Hoever of Willows, County Surveyor of Glenn County, to show its relationship to holdings of the Brown and Moore Ranch. According to his map, about half of the K.B. No. 1, most of the K.B. No. 3, and all the K.B. No. 4 are on the property of this ranch. The four claims run N. 70° W., the claims being contiguous with one another along the length. No workings or manganese ore were seen on the K.B. No. 2 and K.B. No. 3 claims. The K.B. No. 4 claim will be discussed in a separate report (Glenn 8.)

The K.B. No. 1 claim lies in a thick belt of chert of the Franciscan group exposed along the south slope of Elephant Hill. The chert is underlain by sandstone, which covers the lower third of the slope on Elephant Hill. The upper two-thirds of the slope is comprised chiefly of chert. Most of the chert is thin-bedded but some of it is thick-bedded white chert without shale partings. A few small bodies of greenstone are intercalated in the chert. In at least one place the greenstone cuts the chert. The entire slope of Elephant Hill is well exposed. The chert on this slope strikes from N. 70° W. to N. 80° E., and dips 40°-50° N.

The manganese ore is exposed by a cut 10 feet wide and 10 feet deep driven 40 feet into the slope in the direction N. 20° W. The ore occurs as a bed of black oxides 4 feet thick, underlain gradationally by a bed of massive, yellow-brown chert 5 to 8 feet thick. This chert is closely related to the ore. It is entirely massive, showing no bedding planes. Under the hand lens it presents a granular quartoze appearance, similar to a fine-grained quartzite. It seems to be made up of fine quartz grains stained yellowish brown, colorless quartz grains, and yellowish-brown cherty material. There are also scattered clusters of radiating crystals of a brown, platy, opaque mineral which can be scratched with a knife. This mineral appears to have a good cleavage in one direction. Most of the brown crystals are difficult to see even with a lens, but a few reach 0.1 inch in length. They may represent bementite. Much of the massive-yellow brown chert has thin coatings of black manganese oxides along fractures, but some specimens are not so coated. A similar type of chert occurs at the Rattlesnake mine (Glenn 10).

The black oxide manganese ore grades irregularly into the massive yellow-brown chert. The ore probably averages 40 to 45 percent manganese, although many specimens would run 50 percent. Some of the ore has cores of yellow-brown chert and some of massive red chert; but some is nearly free of visible silica. Much of the ore is hard, blue-black psilomelane, but some is soft and crystalline pyrolusite. Examined with a lens, some of the soft black oxides were seen to occur in thin flakes, minutely wrinkled, and presenting a microscopic botryoidal surface. The ore bed and the underlying bed of massive yellow-brown chert are enclosed in thin-bedded red and green chert with shale partings. The ore bed is sheared at the top.

The structure of the ore bed is complex. It appears to be cut by a fault, which may be a faulted anticline, running about N. 20° W. along the west side of the open cut. West of this, the ore bed and overlying chert strike northeast and dip northwest. The strike of the overlying chert at this point is N. 20° E., and the dip 25° NW. As the chert beds approach the fault, they become highly contorted and crumpled.

East of the fault the ore bed and overlying chert strike northwest and dip northeast. The strike of the overlying chert is N. 20° W., and the dip, 75° NE. The chert is highly crumpled and brecciated as it approaches the fault. Although the structure is locally complex, it should be considered as merely a minor wrinkle in a much broader fold, for the ore bed is part of a large belt of chert, along the south slope of Elephant Hill, which has a more or less general strike of N. 70° W. to N. 80° E., and a dip of 40°-50° N. Minor complexities were observed elsewhere in this belt where the chert locally departed considerably from this attitude, and in places was probably faulted.

East of the fault in the open cut, the ore bed is exposed for a length of 15 feet, but it may have extended for 40 feet, for in the southern part of the cut, ore was apparently removed and the bottom of the cut has since been covered. The western faulted limb of the ore bed is exposed along the west wall of the cut for a length of 12 feet. West of this are no exposures, but the bed may continue a little farther. About 40 tons of ore has been removed and piled on dumps around the cut. This ore probably averages 40 to 45 percent manganese.

No. 8. K. B. No. 4 Claim. (By Ivan F. Wilson, July 15, 1942.) The K. B. No. 4 claim is in the N½ sec. 1, T. 18 N., R. 7 W., on a small ridge just south of Salt Creek, south of Elephant Hill, at an altitude of 1,560 feet. It is 4.7 miles by road west of the main road running between Elk Creek and Stonyford. The claim is reached by turning northwest off the main road at the junction of Salt Creek and Stony Creek, 0.3 mile north of the Brown and Moore Ranch, and 3 miles north of Stonyford. This is the road shown on the Forest Service map as proceeding toward Elephant Ridge. About 2.5 miles up this road, a road turns off to the west and leads directly to the mine. The mine is a total distance of 25.5 miles (21 miles by good road, 4.5 miles by poor road) from the nearest shipping point, at Fruto.

The K. B. No. 4 claim is one of the four located by H. D. Bruce of Anderson. According to a map by August J. Hoever of Willows, County Surveyor of Glenn County, it is entirely in holdings of the Brown and Moor Ranch of Stonyford. At present it is subleased to M. C. Syar of Vallejo. Three men were working on the property when visited.

The manganese ore at the K. B. 4 claim lies within a belt of thin-bedded red chert. The chert has a general northwest strike and a southwest dip.

A cut 120 feet long, 20 feet wide, and 10 to 15 feet deep has been opened northward across the ridge. An area 125 by 100 feet has been scraped off the ridge east of this cut. To the west another cut 60 feet wide and 100 feet long has been opened. Two hundred feet west of the main cut is a V-shaped cut across the ridge, the center of the V enclosing an older caved tunnel.

The main ore body runs obliquely northwest across the main cut. It has a general strike of N. 30° W., and a dip of 50° to 60° SW. The operators state that the ore bed was 8 feet wide at the bottom of the cut, but the floor of the cut was obscured when observed by the writer. The bed is 4 feet thick on the west wall of the cut. It is exposed for a length of 100 feet. The operators claim that another bed 5 feet wide was encountered just north of the main bed, and this bed does not crop out on either wall of the cut. Toward the north end of the cut were other aggregates of ore, but not as a definite bed, and they probably represent float. On the walls of the cut at this point is a thick regolith, containing blocks of manganese ore and red chert, but no definite bed is exposed. The soil in parts of the cut is 10 feet deep.

The large area scraped off on each side of the main cut reveals chiefly well-bedded red chert with shale partings. The manganese bed is immediately underlain by a narrow belt of well-bedded manganiferous buff chert. This belt occurs in beds, 1 inch to 4 inches thick. It is a somewhat impure, splintery, shaly chert, buff to yellowish white in color. Manganese oxides occur along bedding planes and fractures. The beds are somewhat warped and crumpled. The manganiferous buff chert is underlain, gradationally, by the extensive well-bedded red chert. On the west wall of the cut the manganese bed is overlain by 3 to 4 feet of hard, flinty, pale-green chert in beds 1 inch to 3 inches thick. This green chert in turn is overlain by well-bedded red chert.

The manganese ore consists essentially of black oxides. Some of the material is distinctly crystalline. No primary manganese minerals were seen. The ore is cut by small quartz veinlets. Some blocks are composed nearly entirely of black oxides, but more commonly they contain cores and patches of cellular yellow silica, or patches and bands of white chert. In several of the large blocks of ore, 2 or 3 feet in diameter, the outermost few inches seem to be almost free from silica, whereas a third to a half of the inner part may be composed of white chert or patches of silica. While some of the material might run 50 percent manganese, it is believed that a general average of the ore which has been piled up is 40 to 45 percent manganese.

The V-shaped cut 200 feet west of the main cut encloses a caved tunnel, which was driven south into the ridge. About 5 tons of siliceous ore has been stacked by the side of this tunnel. The south end of the caved tunnel reveals blocks of black oxide ore, but no bedding is exposed. Blocks of ore are also exposed in the walls of the V-shaped cut to the west and to the east, but they occur only as loose blocks and not as a definite bed. They may roughly mark the course of a bed which occurs at depth below the regolith. The east limb on the V-shaped cut shows buff to greenish chert in beds 1 inch to 2 inches thick. The west limb of the cut is 6 feet deep but reveals only a regolith containing fragments of buff, green, and red chert.

The ore in the V-shaped cut is more siliceous than that of the main cut, containing considerable amounts of white chert. It averages about 35 percent manganese. This bed must be different from that of the main cut, unless faulting occurs between them. Between the main cut and the V-shaped cut red chert is exposed. About 100 feet west of the V-shaped cut is sandstone, which evidently overlies the main chert body.

Approximately 20 tons of ore have been piled up along the road 1 mile east of the mine. Also about 20 to 30 tons are stacked in the canyon just north of the mine. It is said that about 5 tons of ore have been transported to Fruto for shipment.

No. 9. Levensaler and Speir Prospect. (From files of U. S. Geological Survey, 1918.) Records indicate that 62 tons of ore containing 42 percent manganese, 2 percent iron, and 17 percent silica, was produced in 1917 from the Levensaler and Speir properties near Fruto, probably in T. 20 N., R. 6 W.

No. 10. Rattlesnake Mine. (By Ivan F. Wilson, July 16, 1942.) The Rattlesnake mine is south of Salt Creek in the SE$\frac{1}{4}$ sec. 6, T. 18 N., R. 6 W. It is 2 miles southeast of the K. B. No. 4 claim (Glenn 8), at an altitude of 1,250 feet. It may be reached by driving up the road toward the K. B. No. 4 claim for 2 miles, from where the workings at the Rattlesnake mine may be seen on a low hill half a mile to the southwest. The mine is located on the Brown and Moore Ranch of Stonyford. It is not being operated at present.

The development includes a shaft 7 by 7 feet. At present the bottom is 14 feet deep, but it is caved and may have been considerably deeper. According to Bulletin 76,[1] it was 20 feet deep. A drift apparently runs northwest from the shaft for a short distance. A cut 3 to 6 feet deep and 15 feet wide extends for 40 feet southeast of the shaft. Two other cuts, made with a bulldozer, are north and west of the shaft. Neither of these cuts exposes manganese ore. Some 75 tons was shipped in 1918.

The manganese ore occurs in a massive, yellow-brown quartzose chert. This is the same type of rock as that at the K. B. No. 1 claim (Glenn 7), and is described more fully in the report on that deposit. The ore may also contain bementite. Much of it is covered with a film of black oxide, except where freshly broken. The massive chert is 20 feet thick in the vicinity of the shaft. The black oxide ore occurs in pockets and irregular masses within the massive chert, and in many places is intermingled with chert. No large mass of ore is exposed now, although there is some along the walls of the shaft, especially the northwest wall. Bulletin 76 states that the ore body was 4 to 6 feet wide. Most of the ore occurs near the top (southwest side) of the massive chert body. Some of the ore is hard blue-black psilomelane, but some includes pyrolusite. A few pieces of ore were seen which might run 50 percent manganese, but most of the material now exposed contains yellow-brown chert which would lower the grade considerably.

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[1] California Min. Bur. Bull. 76, p. 32, 1918.

Overlying the massive chert and manganese ore to the southwest is 10 feet of thin-bedded green chert, mixed with white and red chert. The chert occurs in beds 0.5 to 1 inch thick with shale partings. A shear zone is between this green chert and the ore body. Southwest of the thin-bedded green chert is a thick-bedded to massive white chert, without shale partings. It occurs in a belt 10 to 15 feet thick, and is overlain to the southwest by sandstone and shale. No exposures were seen northeast of the massive chert and manganese ore.

The massive chert and manganese ore, thin-bedded green chert, and thick-bedded white chert occur in belts running roughly N. 60° W. The attitude at the shaft is nearly vertical, but along the strike in both directions the beds dip to the southwest, indicating that this is the top side. A white chert bed to the southeast strikes N. 60° W., and dips 65° SW.

The ore body appears to be cut off to the north by a fault treading N. 80° W. A cut run in this direction 15 feet north of the shaft reveals sandstone and shale, highly sheared in part. The chert beds and manganese ore strike into this sandstone and shale. The extent of the massive chert and manganese ore toward the southeast is uncertain, but it is exposed for a total length of 50 feet.

It seems possible that most of the ore available on this property has been removed. Only 5 or 10 tons of ore is in sight. The situation at depth cannot be determined, as the shaft is partly caved, and it is unknown whether the ore was removed down to the limit of the oxide zone, or whether some may still remain. The main possibility for future development would probably be in reopening the shaft.

HUMBOLDT COUNTY

No. 1. A.B.C. Manganese Claim. (From files of U. S. Geological Survey, 1918.) The A.B.C. claim is 11 miles north-northwest of Blocksburg on the trail to the Woods mine. It is N. 67° W. of Lasseck's Peak, in the NE¼ T. 1 S., R. 4 E. The claim was located by Mrs. Dave Murphy of Blocksburg. The ore is found in a narrow irregular layer in thin-bedded chert. It is very siliceous, the best ore containing 35 to 40 percent silica. No development work had been done. This prospect is of little economic importance because of the high silica content and the distance from the railroad.

No. 2. Burns Prospect. (From files of U. S. Geological Survey, 1918.) The Burns prospect is 6 miles north-northwest of Blocksburg and 1 mile northwest of the Blocksburg-Bridgeville road. It is on deeded land belonging to Mr. C. W. Manning and is in the southwestern part of T. 1 S., R. 5 E. It was discovered by Mr. Burns of Blocksburg. The prospect is on a flat west of, and above, Basin Creek, a tributary of Larabee Creek. It is 0.5 mile from a branch road which joins the main road 5 miles northwest of Blocksburg.

Because of the heavy covering of soil and the lack of development, no ore is seen in place and little is known as to the extent of ore. Over an area 250 feet in diameter, nothing but float of manganese ore and manganese stained chert could be found. The soil is full of small fragments of soft black manganese ore of good quality. Several large blocks of ore and manganese-bearing chert were found. As the slope is gentle, the blocks could not have come far. Along the east side of the flat, serpentine float is found. This float trends northward and seems to be the surface expression of a dike.

No. 3. Charles Mountain (Woods, Hall) Mine. (By Frank S. Simons, July 5, 1942.) The Charles Mountain mine, sometimes known as the Woods or Hall mine, is in secs. 2 and 11, T. 1 S., R. 4 E., on the top of the ridge between Larabee Creek and the south fork of the Van Duzen River. It is 5.1 miles by a very steep and rough road from the Alderpoint-Blocksburg-Bridgeville road, and 26 miles from the shipping point, Alderpoint, on the Northwestern Pacific Railroad. The mine is on land owned by L. Windbigler, and is operated by F. M. Doak, James Warren, and Joseph Warren of San Francisco. Mr. Joseph Warren is supervising the mining at present. Five men are employed. A permanent camp has been established 0.3 mile from the mine, and an ample supply of water is at a spring 200 feet from the camp. The operators plan to work the property throughout the year, weather permitting. The production of the mine through 1920 is 742 tons.

The ridge on which the mine is located is composed largely of thin-bedded red and brown chert in the northeast part of the area. The geologic relations of the ore body are shown in plate 1. The chert is faulted against sandstone along a zone trending northeast across the northwest corner of the mine area. Within the chert the structure is complex. There are probably many small faults which cannot be mapped. The east slope of the ridge is essentially a dip slope, although numerous small folds and wrinkles give a great variety of attitudes.

Several open cuts are on the east slope of the ridge, all of which appear to have produced some ore, but in only one cut is ore now exposed. The relations of the different cuts to one another are not clear, as outcrops are scarce and attitudes are variable. The rocks have been faulted on a small scale, and this, together with the evident folding, has produced an apparently almost haphazard arrangement of ore outcrops. The amount of ore to be expected here cannot be estimated with the present available information.

The ore on the dumps along the east slope is siliceous, consisting of black oxides of manganese with cores of silica. All of the dumps, however, contain a little carbonate ore, and a few have small amounts of neotocite or bementite ore. The mineral probably is neotocite, as the ore is hard, brown, and apparently amorphous and opaline. None of the cuts appears to be more than 10 or 15 feet deep, so carbonate ore is found here at a rather shallow depth. Perhaps 50 tons of ore can be collected from the various dumps, carrying probably 30 to 35 percent manganese.

The old workings on the north side of the hill consisted of three tunnels and a winze along an ore bed, which presumably is a folded or faulted continuation of the ore body on the east slope. The winze below the lowest tunnel is said to have been in ore all the way down to the 4th level, 50 feet below the 3d level.

Most of the ore on the dump on the north side of the hill is banded gray manganese carbonate, containing probably 40 to 45 percent manganese. There is also a sugary-brown ore in small quantities, and a little low-grade oxide ore with leached white silica cores. Probably the ore to be found with further exploration will be carbonate ore, which occurs at shallow depths throughout the Charles Mountain area.

Work at present is at the portal of level No. 3, which is being opened. Considerable trouble is encountered, as apparently the stope above level 3 has caved, allowing the dump from level 2 to sift down through the cave-in. More than 300 cars of muck have been removed so far, and the end is not in sight. As none of the old tunnels is accessible now, the underground conditions are not known. Probably a considerable amount of ore remains below tunnel 3, as the old map gave no indication that any ore below that level had been removed. There were 4 feet of ore in the No. 4 level, which indicates that the ore may persist at some depth below level 4. Extent along strike at any of the levels is, however, unknown.

Inasmuch as accurate information on any part of the mine is lacking, an estimate of possibilities of the mine would be somewhat premature, and such estimate will have to be withheld pending the successful opening of the No. 3 level. However, it appears to the writer that core drilling might help to find ore in the area.

No. 4. Fort Baker (Porter Ranch) Mine. (By Frank S. Simons and Max D. Crittenden, Jr., July 1942.) The Fort Baker mine, also known as the Porter Ranch mine, is in sec. 32, T. 3 N., R. 4 E., on the north side of Indian Creek. It is 15 miles by road from Bridgeville and 35 miles from Carlotta, the nearest rail point. The road is fair from the mine to Bridgeville; good from Bridgeville to Carlotta. The mine is on land owned by the Russ Company, and was idle at the time visited.

The mine was operated by F. M. Doak in 1918, and 473 tons of ore averaging 47 percent manganese and 13 percent silica, was shipped. It was worked until 1920, when it was abandoned. The total production was 654 tons.

The mine is on a small low knob, conspicuous because of the almost total lack of vegetation other than grass. The geologic relations are shown in plate 2. The rocks are sandstone and chert of the Franciscan group, with two small areas of greenstone on the east side of the ore body. The sandstone in several places appears to grade without perceptible break through a fine-grained siltstone and mudstone into thin-bedded chert, both laterally and vertically through the section. The critical areas are without outcrops, so these gradational contacts are shown by dotted lines.

The sandstone is a soft brown feldspathic rock, which crops out at only one place in the area mapped, and its presence in the area mapped is inferred from the predominance of sandstone float. The chert is generally red, thin-bedded, with partings of shale, and is the rock which encloses the ore bodies. Nearly every outcrop of chert carries thin films of black manganese oxide.

The main chert body appears to be folded into an anticline pitching gently northeast and faulted along the southeast limb. In the ore zone the fault splits, and the rock between the two branches is a much sheared reddish slate with abundant fault gouge and breccia. The main ore bodies appear to have been in this brecciated zone, enclosed in red shale.

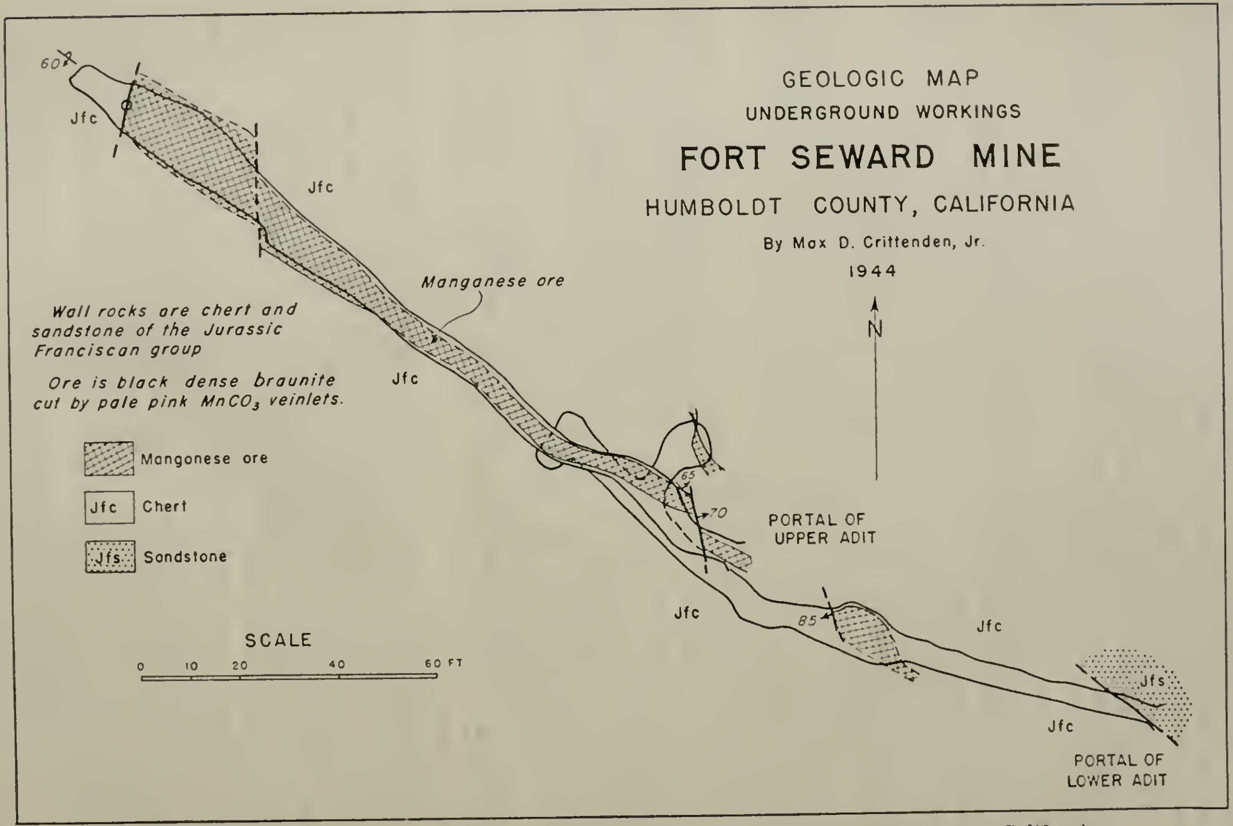
GEOLOGIC MAP
UNDERGROUND WORKINGS
FORT SEWARD MINE
HUMBOLDT COUNTY, CALIFORNIA
By Max D. Crittenden, Jr.
1944
N
Wall rocks are chert and sandstone of the Jurassic Franciscan group
Ore is black dense braunite cut by pale pink $MnCO_3$ veinlets.
Manganese ore
Jfc Chert
Jfs Sandstone
SCALE
0
10
20
40
60 FT
Manganese ore
60
Jfc
Jfc
Jfc
Jfc
Jfc
Jfc
Jfs
65
70
85
PORTAL OF UPPER ADIT
PORTAL OF LOWER ADIT

Figure 1. Geologic map of underground workings, Fort Seward mine, Humboldt County, California.

The attitude of the fault is not known, but the northwest side has been upthrown or has moved northeast relative to the southeast side.

Little ore was in sight in 1942. All the old workings are caved and the cuts are partly filled with debris. Apparently there were at least two ore bodies, the largest in the long open cut at the east side of the area, and a smaller one about 60 feet west. According to E. F. Davis and A. O. Woodford, who examined the mine in 1918, three ore bodies were exposed in the east workings. All the ore seen on various dumps and stock piles will carry at least 30 percent manganese, and scattered around the property are small amounts of ore that contain perhaps 45 to 50 percent manganese. The high-grade ore is hard, blue-black psilomelane, which evidently lies in thin seams in the red shale. The small amount of ore exposed in the present workings is a rather siliceous oxide, probably corresponding to the border zone of Davis and Woodford. The complex structure of the rocks makes the discovery of new ore bodies difficult, but the chances for finding additional high-grade ore seem favorable.

No. 5. Fort Seward Mine. (By E. F. Davis and A. O. Woodford, August 27, 1918.) The Fort Seward mine is owned by the Humboldt Land and Development Company, and is operated by F. M. Doak of San Francisco under a lease. Wilson Wood of Harris, first located the manganese. The mine is in sec. 15, T. 3 S., R. 4 E. It is 6 miles by road to Fort Seward on the Northwestern Pacific Railroad. The roads are fair, the haul all down hill, and ore is transported by motor truck, 3 loads of 5 tons each per day being the the usual haul.

The principal workings are near the top of a small knob on the side of the ridge west of Fort Seward (fig. 1). They consist of two open cuts following an ore zone. The two open cuts come together at the top of the knob, at a place where the ore zone was offset by faulting. The northwest cut has been worked to a depth of 30 feet, the east cut to a depth of 15 feet. The larger part of the ore exposed in the open cut has been removed, but from the blocks still remaining it is clear that the ore lay in lenses parallel to the bedding of the enclosing radiolarian chert.

The chert and the ore zone stand nearly vertical, though the dip varies slightly to one side or the other as the ore zone is traced along the surface, and in the deeper workings the dip is to the east. The central part of the ore zone is offset 10 feet by a fault. The ore zone varies in thickness from 5 to 20 feet. Locally, it contains lenses of massive chert and is underlain on the southwest by a body of chert 100 feet thick. Below this chert is sandstone.

Above the ore zone on the northeast side is a belt of thin-bedded red radiolarian chert, 5 to 15 feet thick, which in turn is overlain by a medium-coarse-grained sandstone. A body of greenstone is within this sandstone, but it does not persist in a direction parallel to the general bedding and it seems to be an intrusive body.

The ore body varies considerably. Near the surface, the ore consists of black oxides with varying amounts of intermixed silica. The greater part of the black oxide ore is hard and of very compact texture. Only a small amount of soft ore is present. One specimen typical of such ore gave the following assay: manganese, 55.0 percent; silica, 14.2 percent; iron, 0.9 percent; available oxygen 3.01 percent. The oxide ore varies in its silica content. Hand sorting is necessary. The amount sorted per man averages 0.5 ton a day.

The primary ores appear in the deeper part of the workings and in cores in blocks of ore near the surface. For the most part the primary material consists of a brown, yellow-brown or cream-colored manganese carbonate and a brown ore consisting of an intimate mixture of silica and manganese oxide in a lower form of oxidation than is present in the black oxides. This ore material has a resinous luster and is spoken of as "rosin jasper." A sample of somewhat siliceous brown carbonate ore gave manganese, 23.9 percent; insoluble, 20.0 percent; iron, 0.5 percent; available oxygen, 0.09 percent; carbon, 22.5 percent.

These primary ores are cut by scattered veins of pink rhodochrosite or more rarely by veins of a lavender-pink hydrous manganese silicate. Numerous transitions from brown carbonate or brown ore to black oxide may be seen along joint cracks or bounding surfaces of the ore body.

Operations began at this mine on November 1, 1917. In 10 months 450 tons of ore had been shipped to the Noble Electric Steel Company. The car shipments varied between 15 and 20 percent silica. One car averaged 23 percent silica and one car was rejected because of high silica. In addition to the ore shipped, 275 tons of second-grade siliceous ore are piled on the property. This ore consists of black oxide, which is separated from the shipping ore in sorting, and also it includes a considerable proportion of unoxidized brown carbonate and brown ore that was too siliceous to ship. A general sample gave manganese, 34.4 percent; insoluble, 37.8 percent; iron, 1.3 percent.

Six hundred feet S. 50° E. of the open cuts on top of the knob, an irregular open cut exposes ore. It may be that the ore here is a continuation of the ore zone farther up the hill. This is not certain, however. There is some faulting, the effects of which are visible in the lower cut; furthermore, the strike of the chert beds between the two workings changes abruptly in places. About 40 tons of ore has been removed and only a very small amount of ore remains. Owing to the presence of several minor faults the relation of chert and ore is not certain. It is not possible to predict the future production of this working place.

Fort Seward Mine. (Supplementary report by M. D. Crittenden, August 1944.) The Fort Seward mine was worked by shallow open cuts during World War I, and a production of 450 tons is reported. It was leased to Mr. J. P. Warren in 1943 (?), who has made the following production:

Year	Long tons (Nat.)	Mn	Fe	SiO_2	H_2O
1943	1,370	41.00	1.75	25.0	5 (est.)
1944	1,640	42.00	1.5	28.0	2.6
Total	3,010	41.6			

The total production including the ore produced in World War I is 3,460 tons, averaging 42.3 percent manganese.

The recent production has come from a bulldozer cut through the top of the knoll, and from two adits on the eastern slope. In August 1944, the upper adit had been driven 160 feet, and the ore stoped from there to the surface. A second adit was begun 35 feet lower, and the ore was being stoped between them. The ore bed was encountered in the lower adit, 56 feet from the portal, but a cross fault which displaced the ore to the north was not recognized, and the working was continued in the barren footwall for some distance (fig. 1). The ore zone was picked up again in a small crosscut 115 feet from the portal.

The ore zone in the Fort Seward mine occurs near the top of a lens of chert, enclosed in sandstone of the Franciscan group. The general strike is N. 50° W., and the dip is steep to the northeast. The ore zone is reported to have been as much as 15 feet thick in the upper adit, but the average is probably 6 to 8 feet. Several steep cross faults which displaced the ore a few feet north on the west side were exposed in the workings. The displacement was 5 to 6 feet on the two faults near the portal of the upper adit. The operator, however, has made no attempt to locate the displaced segment of the ore west of the fault near the face of the upper adit. This block should be prospected by a crosscut northwest of the fault.

The wall rocks above and below the ore are thin-bedded gray chert with more or less hematitic shale partings. Ten feet below the ore, massive red and yellow jasper, at least 10 feet thick, is exposed in the face of the lower adit. The ore itself occurs as a single massive bed of dense black material that was identified by means of its X-ray powder pattern as braunite mixed with silica. The only other mineral recognized is pink hydrothermal rhodochrosite, found in veinlets cutting the older braunite.

A block of ore 4 feet thick, 30 feet high, and 180 feet long lying between the lower and upper adits was indicated by the exposures, in August 1944. Additional ore can be inferred to exist below this level and in the offset segment of the bed at the west end of the upper level.

No. 6. Janes Creek Prospect. (By A. O. Woodford, September 10, 1918.) William Dawkins of Eureka and associates have a mineral lease on 320 acres of land belonging to N. H. Falk of Arcata. The lease includes the Janes Creek manganese prospect, first found by David Miner, a good seeker of Arcata. The prospect is in sec. 21, T. 6 N., R. 1 E. It is 3 miles north of Arcata and 0.5 mile from the Northwestern Pacific Railroad on Janes Creek. The altitude of the prospect is 100 feet. The road to the railroad is in poor shape. Since September 1918, the small prospect hole has been enlarged to a cut extending 20 feet into the hill, at which point the cut is 15 feet deep. The average width is 5 feet, but the ore body pinches out within a short distance.

Most of the exposures in the Arcata district are of a soft buff sandstone, presumably of late Tertiary age. At three places other hard rocks were observed. A street cut in Arcata shows a feldspathic sandstone (Franciscan?) unconformably below the soft buff sandstone. Five miles north of Arcata, on Warren Creek, a large knob of greenstone of the Franciscan group contains euhedral feldspars and is locally spotted with chlorite. Between these two exposures is the manganese deposit on Janes Creek.

The ore body is an almost vertical bed in a decomposed feldspathic rock, probably a tuff. The ore is 12 to 18 inches wide. Parallel to the ore body, and 2 or 3 feet from it, is a zone of chert nodules. Shale is interbedded with the ore. The ore zone strikes N. 10° W., and dips 80° E. The ore is entirely black oxide and most of it breaks up very easily. Analysis of material submitted by the owners to Mr. Gallagher, a Eureka assayer, gave 51 percent manganese, and less than 1 percent silica. In the field the average grade of the ore body was estimated to be 40 percent manganese and 15 percent silica. A sample collected for analysis from various parts of the face, gave manganese, 41.5 percent; iron, 5.5 percent; silica, 8.1 percent. Some ore is hard and steely, and undoubtedly is high in manganese.

The ore is jointed every few inches, and all joint planes are thickly coated with sticky yellow clay or ocher. Near the footwall are numerous thin partings of red shale, parallel to the wall. This shale is similar to the thicker laminae of shale in the country rocks near by, and to the shale seen elsewhere in manganese deposits of the Franciscan group.

The small accessory ore body on the footwall side of the main mass bounded on one side by chert, may be a faulted portion of the main body. In that case the intervening tuff abruptly lenses out. The main ore body seems to be entirely enclosed in a decomposed feldspathic igneous rock, probably tuff. On the hanging-wall side this rock is massive and coarse-grained, and though easily broken with the hands, is good standing ground. It shows manganese films along joint planes. The footwall material is similar, but finer-grained. Neither wall of the ore body is sheared. The lenses of chert near the footwall are of a number of types. Some of them have probably been separated by shearing along the enclosing red shale. The surfaces of some nodules of chert are slickensided, and a peculiar green clay or gouge is present in small amounts.

The large lenses are greenish or brownish massive chert typical of the Franciscan group. Some of the smaller chert nodules are brilliant red, with white porous cores and manganese stains along fractures. Other brilliant red nodules are composed of porous bright red ocher. Still other nodules are hard, dense, and bright yellow, and some are heavy, brown, and submetallic, evidently containing considerable iron. The long axes of the ellipsoidal cherts are usually, but not always, roughly parallel to the walls of the ore body. No thin-bedded red chert with shale partings was found. No radiolaria could be seen with a hand lens. About 12 tons of ore was mined.

No. 7. Leaning Tree No. 2 Claim. (By Frank S. Simons, July 30, 1942.) The Leaning Tree No. 2 claim is in the NE¼ sec. 9 and the NW¼ sec. 10, T. 6 N., R. 4 E., on the ridge west of Ruby Creek, a tributary of Willow Creek. The claim notice is near Highway 299. The claim was located by Thomas O. Millett, Mae Stinson, and Jess L. Millett on June 23, 1942, and trends 1,500 feet east from the discovery point. It is 7 miles west of Willow Creek and 40 miles east of Arcata, the nearest railroad point.

In this vicinity the cuts along Highway 299 expose quartzite and slate, which strike approximately east and dip south at different angles. These rocks are intruded by, or faulted against, hornblende diorite and greenstone. In a gouge zone in the greenstone the sheared material is thinly filmed with purplish manganese oxide. The zone is 3 feet thick and is exposed for 15 feet in the face of the road cut. No ore was found, and the best material seen probably carries less than 5 percent manganese. The prospect is of little value, and no development work has or should be done.

No. 8. Live Oak Deposit. (By Parker D. Trask, April 8, 1942.) The Live Oak deposit is in the NW¼ sec. 6, T. 4 S., R. 6 E., a few hundred feet west of the east border of Humboldt County, at an altitude of 3,000 feet. The deposit is on the Rohrbough ranch, and is under lease to Rae F. Helmke. It is reached by a crude bulldozed road 0.3 mile from the end of the existing road 8 miles from Alderpoint. The deposit lies in thin-bedded red chert adjacent to a large mass of greenstone in a country characterized by landslides. The chert strikes N. 55° W., and dips 15° NE. The ore body consists of a thin lens of oxide 6 inches in thickness exposed in a cut for a distance of 6 feet. The grade is high, 45 percent manganese, but the quantity of ore is small, as the ore body is cut off by greenstone within a few feet of the present exposure.

No. 9. Martin and Murphy Claim. (From files of U. S. Geological Survey, 1918.) Messrs. Charles Martin and Thomas Murphy of Blocksburg have a manganese claim in T. 1 S., R. 5 E., about 2.5 miles east of the Charles Mountain mine (Humboldt 3). The ore body is said to be 18 inches wide. A sample of this ore showed a core of gray manganese carbonate surrounded by a shell of oxide. No development has been done.

No. 10. Murphy Prospect. (From files of U. S. Geological Survey, 1918.) The Murphy prospect is 5.5 miles by road and trail northeast of Alderpoint, 0.3 mile from the Trinity County line. It is 0.5 mile south of the Alderpoint-Zenia road, probably in the W$\frac{1}{2}$ sec. 7, T. 3 S., R. 6 E. This prospect is on deeded land belonging to Mr. Jean and was discovered by Dave Murphy of Blocksburg.

Siliceous manganese ore and manganese-stained chert crop out at several places along a north-northeast trending ridge north of Dobbin Creek. The best prospect occurs in thin-bedded crumpled and contorted red chert near the saddle where the telphone line crosses the ridge. Considerable float of siliceous ore is seen, and one small layer 4 inches wide was found in place. A few narrow veins of psilomelane cut the bedding of the chert. The ore consists of siliceous psilomelane and pyrolusite and seems to have been derived from a manganese carbonate and chert. The general strike of the rocks is N. 25° W., at right angles to the trend of the ridge. The dip is to the north. The chert is overlain by sandstone. About 80 to 90 yards up the ridge N. 25° E. from this outcrop is another belt of chert, 75 feet thick. This chert strikes N. 50° W., and dips 60° to 65° NE. Near the middle of this chert belt is a 6-inch bed of siliceous manganese ore. The unaltered cores of chert are pink to red in color and are dotted with numerous dull white specks which seem to be manganese carbonate. This ore is too siliceous to be of economic importance. Several similar layers were seen within a radius of half a mile.

No development has been done on any of these outcrops. The first outcrop mentioned is the only one of any promise and here only 20 tons of rather siliceous ore are in sight. Since the prospect is near a good road and only 5.5 miles from the railroad, prospecting would be justified but only on the outcrop first described.

No. 11. Prior No. 1 Deposit. (By Parker D. Trask, April 9, 1942.) The Prior No. 1 deposit is on the Prior Ranch in the SW$\frac{1}{4}$ sec. 25, T. 2 S., R. 5 E., at an altitude of 2,500 feet. The deposit is about 2 miles by trail from the end of a road and 8 miles from Fort Seward, the nearest rail point. It is under lease to Rae F. Helmke of Alderpoint.

The ore body consists of a bed of oxide 1.5 to 2 feet in width and 20 feet long. It is in thin-bedded chert that extends up the hill for at least 600 feet. The ore body has not been outlined completely by present exploration, and may extend farther up the hill than current development indicates. The grade of the deposit is estimated to be 45 percent manganese. About 5 tons of 45 percent ore lies on a stock pile.

No. 12. Red Knoll Deposit. (From files of U. S. Geological Survey, 1918.) A deposit called the Red Knoll, located near Fort Baker, is listed in the files of the U. S. Geological Survey. The operators are said to be J. M. McKnight, et al.

No. 13. Sam Brown (World War No. 2) Prospect. (By Frank S. Simons, August 4, 1942.) The Sam Brown prospect is on the Hoopa Valley Indian Reservation, in sec. 15, T. 8 N., R. 4 E., on the north flank of

Scottish Point. It is held by Sam Brown of Hoopa, and is named the World War No. 2 claim. It trends northwest 750 feet from the upper outcrop. The claim is 3 miles by trail from a poor road, which leads 3 miles to Hoopa. Hoopa is 41 miles from Arcata, the nearest railroad point. No development has been done.

A thick bed of quartzite forms a low bridge. Interbedded with the quartzite is a bed of rhodonite ore averaging 6 feet in thickness and exposed for 40 feet along the strike, which is approximately east. Coarse-grained gabbro crops out 50 feet east of the east end of the ore bed, and the contact may be either intrusive or a fault. It is not exposed at any place. The west end is buried, but 400 feet west of the last exposure is an outcrop of siliceous rhodonite ore 6 feet thick. There are no intervening exposures of ore, so this outcrop may be either a continuation of the upper ore bed or, more likely, a large piece of float.

The rhodonite at the upper outcrop is a very fine-grained bright pink dense rock. Small amounts of pyrite, native copper, and malachite (?) are present. Some of the ore resembles siliceous brown ore found in the Mad River district in Trinity County (Trinity 20, 37, 44).

Excluding the lower outcrop, 250 tons of rhodonite ore averaging 10 to 35 percent manganese is reasonably expectable. A small amount of oxide ore is also present, but probably not more than one ton, averaging 40 percent manganese. If two exposures are parts of the same ore body, a much larger tonnage is available. Any estimate of this tonnage would be highly conjectural, however.

No. 14. Windbigler No. 1 Mine. (By Frank S. Simons, July 6, 1942.) The Windbigler No. 1 mine is in T. 1 S., R. 4 E., probably in sec. 15, on land owned by L. Windbigler of Bridgeville. The mine is on the west side of Charles Mountain, 1 mile from the road to the Charles Mountain Mine (Humboldt 3), and 24 miles from Alderpoint, the nearest railroad point. It is being operated by James and Joseph Warren of San Francisco.

A series of landslide benches forms part of the west slope of Charles Mountain. At the edge of one of these benches, a ledge of sandstone strikes north, and along the east slide of this ledge numerous boulders and fragments of manganese ore have been found in an area 100 feet long and up to 25 feet wide. Prospecting has been carried on to a depth of 6 feet, entirely in landslide material and soil.

The ore is found as fragments ranging in weight from a few pounds to 600 pounds. Most of the ore is soft black manganese oxide, and generally contains leached silica skeletons which make the ore rather porous. A few of the fragments have cores of gray laminated manganese carbonate, similar to the ore found at the Charles Mountain mine (Humboldt 3), and one fragment was oxidized to a depth of only 0.5 inch. The source of the ore has not been found, and, as several landslide benches are above the deposit, the source will be difficult, if not impossible, to find. The operators plan to prospect by stripping the surface with a bulldozer.

No. 15. Windbigler No. 2 Prospect. (By Frank S. Simons, July 5, 1942.) The Windbigler No. 2 prospect is in sec. 11, T. 1 S., R. 4 E., on patented land owned by L. Windbigler of Bridgeville. It is 1 mile by trail from the road to the Charles Mountain mine (Humboldt 3), and 26 miles from Alderpoint, on the Northwestern Pacific Railroad. It is leased to James and Joseph Warren of San Francisco. The prospect lies on the north slope of Charles Mountain in a hummocky area that is probably part of a large landslide. The ore is found on a small knoll composed largely of brown and white well-bedded chert striking N. 45° W. and dipping 70° SW. The chert crops out for 100 feet along the strike. At the southeast end of the exposure of chert are numerous fragments of high-grade manganese oxide ore. The only ore in place consists of a few thing stringers in the chert.

A mass of altered gabbro crops out 70 feet south of the chert, and 150 feet west is an exposure of sandstone. Sandstone also crops out 30 feet stratigraphically above the chert. Probably less than 10 tons of ore, averaging 45 to 50 percent manganese, will be found here.

IMPERIAL COUNTY

No. 1. Claim of Unknown Name North of Chocolate Drop Group. (By Ivan F. Wilson, March 12, 1943.) A claim of unknown name is 0.5 mile north of the Chocolate Drop group, on the west side of the road running south from Wiley Well. The deposit is probably in sec. 9, T. 9 S., R. 20 E. It is 32 miles by road from Blythe, the nearest shipping point. A few surface cuts have been developed. It is unlikely that there has been any production from the property.

The deposit consists of manganese oxide, which forms a cement in sandstone and conglomerate. The host rocks are similar to the fanglomerate wall rock of the Chocolate Drop deposit (Imperial 3). The manganese oxide may partly replace the matrix of the sandstone and conglomerate, but the individual grains and fragments appear to be coated by oxide, and not replaced to any great extent. The manganese oxide seems to follow certain layers of the sandstone, although in detail its distribution is irregular. The open cuts are on a dip slope of the manganese-bearing formation. The strike is northwest and the dip is about 15° NE. The manganiferous material is exposed over an area of 100 feet square. The thickness of the zone of material completely coated by oxide is 1 foot. An assay of a representative sample shows a manganese content of 12.07 percent.

The deposit closely resembles the Orchard or Dunbar deposits near Lake Havasu (San Bernardino 16). The Orchard deposit is thought to have been derived from manganese oxide solutions spreading out into fanglomerate from fissures, and it is likely that this deposit may have formed in the same way. No definite fracture zones seem to cut the deposit, but numerous fissures are in the vicinity, as described in the report on the Chocolate Drop group (Imperial 3).

Economic possibilities of this deposit are negligible, because of the low grade of the material. It is difficult to see how any form of mechanical concentration would be successful. The deposit is of about the same type and grade as the Orchard deposits, but is much smaller. Unless some use is found for the ore in the Orchard deposits, there is little reason to attempt to develop this deposit.

No. 2. Anson Prospect. (From files of U. S. Geological Survey, 1918.) A deposit near Glamis is reported to have produced 72 tons of manganese containing 36 percent manganese, 1 percent iron, and 15 percent silica. The owner is given as W. J. Anson.

No. 3. Chocolate Drop (Big Bear, Black Jack, Black Queen, Ebony) Group of Claims. (By Ivan F. Wilson, March 12, 1943.) The Chocolate Drop group of claims is at the west end of the Palo Verde Mountains in sec. 9, T. 9 S., R. 20 E. It is reached by proceeding 17 miles west of Blythe, then turning south for 15.5 miles. The mine is 6.5 miles south of Wiley Well, a total distance of 32.5 miles by road from Blythe, the nearest shipping point. The claims are owned by O. H. Tetzlaff of Banning, and were leased January 30, 1942, to the Mine Development Company, of which H. S. West of Los Angeles, is president.

The group comprises four claims, called the Chocolate Drop, Black Queen, Black Jack, and Big Bear. The major development is on the Chocolate Drop claim, which has provided all the production known so far. The Ebony group is a old name for the deposits. The Black Queen claim was not seen.

According to the report by Sampson and Tucker,[1] the Chocolate Drop group in 1917 had a production of 300 tons of ore, which averaged 46 percent manganese, 2.2 percent iron, and 2 percent silica. During 1942 the present lessees shipped 30 tons of ore containing 42.18 percent manganese to the Metals Reserve stock pile at Phoenix, Arizona. The property was idle when visited, and it was understood that operations had been abandoned because of the difficulty of sorting ore of shipping grade.

The Chocolate Drop group consists of fissure deposits of manganese oxide occurring in fanglomerate, and, in one place, in andesite. Several different fissures occur over an area half a mile wide. The fissures strike approximately north and are vertical or steeply dipping. Brecciated zones along the fissures are cemented with manganese oxide and the matrix is partly replaced by manganese oxide. Veinlets of manganese oxide and of later white calcite cut the fissure zones. The manganese oxide is mainly hard, black, botryoidal material of the psilomelane type. In places bands of this hard oxide alternate with bands of soft black crystalline oxide which is presumably pyrolusite, or possibly manganite. Most of the fissure zones are of low grade, although in a few places the veinlets of manganese oxide are sufficiently concentrated to give a product containing about 40 percent manganese.

The fanglomerate in which the fissures occur is orange to brown, coarsely stratified, and poorly sorted, containing subangular pebbles averaging 2 to 3 inches in diameter, but ranging up to 1 foot or 2 feet. The pebbles are mostly of andesite. There are interbeds of sandstone 2 to 3 feet thick. At the Chocolate Drop claim the fanglomerate strikes N. 35° W., and dips 10° NE. The major development is along a fissure on the Chocolate Drop claim from which all production to date has been obtained, so far as known. Ore has been stoped on this fissure over a length of 95 feet, and followed by an open cut to the north an additional 65 feet. The fissure continues farther north for several hundred feet, but is nearly barren over this distance. The fissure strikes N. 10°-20° W., and is vertical for the most part, or in places dips steeply to the west. At the face of the stope the ore zone is 2 feet thick at the roof, tapering down to a thickness of 1 foot at the floor. The ore body seems to have been 3 or 4 feet thick in the main part of the stope, but it pinches out at the bottom.

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[1] Sampson, R. J., and Tucker, W. B., Mineral resources of Imperial County: California Div. Mines Rept. 38, p. 129, 1942.

The stope reaches a maximum depth of 28 feet below the surface at the south end. The stope is open to the surface for the most part, but in two places pillars were left on the roof. Two small open cuts, 15 and 25 feet south of the shaft, reveal only barren fanglomerate; however, it is possible that they are off the line of strike of the fissure. Parts of the stope wall are lines with botryoidal psilomelane, but this psilomelane does not extend far into the wall rock, except as narrow veinlets. A sample from the 2-foot zone of ore at the south face of the stope contains 41.15 percent manganese.

The bottom of the stope is inclined upward to the north, running into an open cut 65 feet long and 5 to 6 feet deep in which the material was apparently too low in grade to provide shipping ore. The fissure continues as a barren zone still farther north. A fault surface is well exposed in a cliff near the south end of this canyon. It has a smooth surface with prominent grooves pitching 15° N. The fault at this point strikes N. 15° W., and dips 75° W. It is followed by a layer of jasper 0.1 to 0.2 inch thick. Farther north the fault contains a psilomelane breccia 2 inches thick, consisting of fragments of psilomelane and wall rock cemented by soft black oxide. Still farther north the fault splits into two branches. An open cut along one of these branches has followed a psilomelane veinlet 2 to 4 inches thick. Other branching narrow veinlets occur in the vicinity.

Another fissure lies 300 to 400 feet west of the main fissure. It is exposed by open cuts and trenches over a length of 75 feet. It strikes N. 5° E., and dips vertically. One open cut reveals a zone 5 feet wide containing psilomelane type veinlets 1 inch to 4 inches thick. The proportion of wall rock is too great to make mining of this material feasible. Small veinlets of psilomelane are exposed 300 feet to the south along the same fissure.

The Big Bear claim is 1,000 feet west and slightly south of the Chocolate Drop claim. Four open cuts have been developed along a fissure zone followed by narrow veinlets of psilomelane. At the north end a cut 15 feet long exposes 0.5 to 1 foot of breccia impregnated with manganese oxide. Psilomelane veinlets crop out on the surface to the north and south. Another open cut, 70 feet S. 10° E. from the first cut, is 20 feet long and 4 feet deep. It exposes psilomelane vein material, containing a few brecciated fragments of wall rock, and is 3 to 4 inches thick. The fissure here strikes N. 20° W., and dips 70° E. Cut number 3, 50 feet S. 18° E. from cut Number 2, is 60 feet long and 2 to 6 feet deep. The fissure here strikes N. 20° W., and dips nearly vertically. The cut exposes several diverging psilomelane veinlets, some of which contain brecciated material. The veinlets attain a maximum thickness of 6 inches, but most of them are thinner than this. Cut number 4, located 190 feet S. 30° E. from cut number 3, is probably on a different fissure. Psilomelane veinlets are exposed at intervals on the surface between cuts 3 and 4, but they strike at an angle to the line between the cuts. Cut number 4 is 70 feet long and 3 to 8 feet deep. It exposes the best ore on the Big Bear claim, attaining a thickness of 0.5 to 1 foot. The ore averages 0.5 foot in thickness over a length of 50 feet. In part it is a high-grade banded and botryoidal oxide of the psilomelane type, in part it consists of fragments of wall rock. The average grade of the zone is perhaps 25 percent manganese, but a little 40 percent ore could probably be obtained by careful sorting. The main vein at this cut strikes N. 20° W., and dips 85° W. On the whole the Big Bear claim is less favorable than the Chocolate Drop claim.

The Black Jack claim is about half a mile west of the Chocolate Drop claim. This deposit occurs in andesite, which underlies the fanglomerate of the Chocolate Drop and Big Bear claims. The andesite, weathering to a reddish color, is amygdaloidal, the amygdules being lined with a pale-green mineral. At least three separate veins are exposed, and numerous other veinlets cut the andesite on the surface. The western vein crops out in three open cuts over a length of 230 feet. It strikes N. 15° W., and dips 65° E. At the south end is a vein of solid ore 3 to 4 inches thick, widening out into 8 inches of brecciated material. Thin veinlets extend into the hanging wall. Fifty feet north of this cut is an exposure of 6 inches of nearly solid ore in a 3-foot zone of veinlets and wall rock. Sixty feet farther north is a cut 20 feet long exposing a 5-foot zone cut by psilomelane veinlets. The individual veinlets are only a fraction of an inch to 2 or 3 inches thick, however, and there is too much wall rock to make mining feasible. At the north end of this fissure a small open cut reveals veinlets of psilomelane penetrating the andesite.

Another vein 100 feet east of the vein described above has been developed by an open cut. This cut exposes a psilomelane breccia zone up to 1 foot thick which tapers rapidly at each end of the cut. About 200 feet east of the first-mentioned vein, two other cuts are located on a different fissure zone. These cuts expose a vein of psilomelane up to 8 inches thick containing brecciated fragments of wall rock. Most of the veins on the Black Jack claim are too narrow to be mined economically.

The possibilities of the Chocolate Drop group of claims are none too promising in view of the low average grade of the ore and the thinness of most of the zones that contain moderately high grade ore.

No. 4. Desert Bloom Prospect. (Condensed from original description in California Div. Mines Rept. 38, p. 129, 1942.) A deposit called the Desert Bloom prospect is in sec. 24, T. 9 S., R. 20 E., 21 miles from Blythe. It is owned by H. L. Jackson of Brawley and Edward Rochester of Winterhaven. The deposit consists of manganese oxide in conglomerate. The ore zone is 8 feet thick. It strikes N. 45° W., and dips 35° SE. The average grade is about 20 percent manganese. The deposit has been explored in open cuts but has produced no ore.

No. 5. Lugo (Lost Donkey, Palo Verde) Claims. (By F. S. Hudson and R. R. Morse, October 6, 1918.) T. Lugo of Palo Verde has two claims for manganese in sec. 35, T. 9 S., R. 20 E., in the Palo Verde Mountains, 8 miles by road south of Palo Verde. They are known as the Lost Donkey No. 1 and No. 2. A fair road connects them with Glamis, which is on the line of the Southern Pacific Railroad, 30 miles southwest.

There are at least four distinct veins on the No. 2 claim. These veins strike N. 55°-60° W., and dip south from 60° to almost vertical. The country rock is dark-gray lava, probably andesite. The vein materials are black manganese oxides, calcite, and fragments of wall rock. The manganese oxides show various peculiar stalactitic structures. The most common structure is an arborescent form, built up of minute cylindrical rods. Another form is made up of a series of wavy plates, standing at right angles to the wall from which they grew. The plates are from 0.1 to 0.2 inch thick and have rounded edges and corners. The structure strongly suggests transverse enamel plates of an elephant's tooth. The fragments of wall rock are commonly impregnated by black oxide and in places are partly replaced by the manganese minerals. Apparently there were two periods of mineralization, in the first of which the manganese was deposited. A reopening of the fissure was followed by deposition of calcite which failed to fill the opening completely, leaving a vug. When this vug was exposed by erosion, it was filled loosely with soil and rock that dropped in from above. These veins have many characteristics in common with those seen on the U. S. group of claims south of Aguila, Arizona.

The northernmost of the veins shows two layers of ore, each less than 1 foot thick. Considerable waste is found with the ore, but exploration work here is advisable. A short distance to the south is the most important vein on the property. This vein can be traced for at least 150 yards along the strike. Near the southwest end, the vein is 2 feet wide but contains considerable waste rock. At the northeast end 3 feet of excellent ore is exposed.

Sixty yards south another vein has been opened for 50 feet along the strike by tunnel and open cut. Much calcite is associated with the manganese oxides here and the ore of good grade is less than 1 foot in thickness. About 10 tons of ore has been mined and stacked here. Most of the 37 tons shipped from the property came from this locality. A fourth vein, lying 20 yards to the southeast from the last mentioned vein, is of the same character and not economically attractive.

No. 6. MacDonald Prospect. (Condensed from original description in California Div. Mines Rept. 38, p. 130, 1942.) A deposit owned by Edward MacDonald of Brawley, is in sec. 12, T. 9 S., R. 20 E., about 20 miles from Blythe. The ore is found in veins having a maximum width of 2 feet in andesitic breccia. The strike of these veins is N. 45° W., and the dip is vertical. Development consists of open cuts, but no ore has been produced.

No. 7. Pilot Knob (Lincoln, Well-Earned) Prospect. (From files of U. S. Geological Survey, 1918.) The Pilot Knob deposit is 15 miles northeast of Glamis in T. 12 S., R. 19 E. The owner is said to be M. C. Turner of San Diego. The ore is reported as running 35 to 40 percent manganese and 15 percent silica. No details of the mode of occurrence are available.

No. 8. Southern Pacific Deposit. (Modified slightly from original description in California Div. Mines Rept. 38, p. 130, 142.) A manganese deposit is in the E$\frac{1}{2}$ sec. 33, T. 9 S., R. 20 E., about 23 miles from Blythe, on land of the Southern Pacific Land Company. The manganese occurs in andesite in stringers 6 to 12 inches in thickness. The strike of the stringers is N. 70° E., and the dip is vertical. The stringers are offset by a fault trending N. 70° W. The deposit seems to be a typical oxide fissure deposit.

No. 9. Turtle Prospect (Hodges Group of Claims). (Modified slightly from original description in California Div. Mines Rept. 38, p. 129, 1942. Also visited by J. B. Hadley of the U. S. Geological Survey, 1941.) The Turtle prospect is located in sec. 16, T. 11 S., R. 21 E., 3 miles east of Midway Well, 32 miles from the railroad at Glamis, and 2 miles from the nearest road. The owner is E. D. Hodges of Yuma, Arizona. The deposit consists of a series of fissure veins of manganese oxide in andesitic breccia. The veins strike N. 30° W., and are vertical. They are 1 foot to 3 feet wide. The grade is 20 percent manganese, 1.2 percent iron. The property has been explored in open cuts, short tunnels, and shallow shafts but has produced no ore.

No. 10. War Manganese Mine. (By Ivan F. Wilson, March 11, 1943.) The War Manganese mine is at the south end of the Paymaster district, just south of the Whedon claims (Imperial 11), in sec. 19, T. 11 S., R. 21 E. It is 32 miles by road from the nearest shipping point, Glamis, and is 42 miles by road south of Blythe. The mine covers the southernmost vein shown on the map in Hadley's report on the Paymaster district.[2]

The mine is covered by a claim called Claudius No. 1 located by C. R. Zappone, Ethel Zappone, and Morgan Lesher. It is being operated under the name of the War Manganese Company of Los Angeles. About 6 men were working on the property when it was visited.

An unknown amount of ore, probably not over 300 tons, was shipped from here during World War I, the production being included in the figures for the Paymaster district. The War Manganese Company shipped 24 tons of ore to the Phoenix stock pile in February 1943. This ore contained 14.15 percent manganese, 1.40 percent iron, and 13.60 percent silica.

The major development is a shaft and series of stopes along one of two veins. A crosscut tunnel 75 feet long, extending S. 75° E. into the hill strikes the vein at a depth of 40 feet below the surface. The vein is stoped out for a distance of 30 feet south of the crosscut and perhaps 30 feet deeper. The stope extends 55 feet north of the crosscut, the bottom being irregularly inclined through this distance. Parts of these stopes were excavated from a shaft during World War I, but the crosscut was made during World War II.

The deposit is similar to those farther north in the Paymaster district (Imperial 11) and consists of fissure veins cutting fanglomerate. Two veins are exposed. They consist mainly of material of the botryoidal psilomelane type, occurring as veinlets and stringers and surrounding and partly replacing fragments of wall rock. The manganese oxide is accompanied by calcite. The main vein strikes N. 10°-15° E., and is nearly vertical. It cuts fanglomerate which strikes N. 70° W., and dips 20° N. The roof of the stope above the crosscut reveals stringers of psilomelane in a fissure zone 3 feet wide. This material is low grade, and could not be considered ore. Pillars left in the stope reveal similar material. However, on the south face of the stope south of the crosscut, 2 feet of ore is revealed. The stopes indicate that ore having a possible thickness of 2 to 3 feet might have been stoped out. This vein may be traced on the surface for a distance of 40 feet south of the shaft, beyond which it becomes a barren fissure. An open cut 100 feet farther south reveals psilomelane in a breccia zone about 1 foot thick. This ore is low grade and unpromising.

Another open cut along a parallel vein, 25 feet east of the vein previously described, reveals good ore in veinlets 6 to 8 inches thick penetrating a zone 3 feet wide. This vein strikes N. 20° E., and dips 75° E. The ore here contains considerable soft black oxide in addition to psilomelane.

About 10 tons of ore lies on the dump in front of the main stope. This ore consists of oxide of the psilomelane type and of soft black oxide, accompanied by calcite, with many rock fragments, mostly andesite (the main type of fragmental material in the fanglomerate). A sample from this dump contained 31.09 percent manganese, 1.48 percent iron, and 17.57 percent silica.

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[2] Hadley, Jarvis B., Manganese deposits in the Paymaster mining district, Imperial County, California: U. S. Geol. Survey Bull. 931-S, 1941.

It is possible that the main vein at this property is largely mined out. The second vein discovered to the east may yield additional ore.

No. 11. Whedon (Paymaster District) Claims. (By Ivan F. Wilson, March 11, 1943, and J. B. Hadley, February and March, 1941.) The field work for Jarvis B. Hadley's report on the Paymaster district[3] was done in February and March 1941, before development during the present war had started. The purpose of the present report is to record the recent production and development and to give the present status of the district which is in secs. 18 and 19, T. 11 S., R. 21 E.

Except for the War Manganese mine in the southern part of the district, described in a separate report (Imperial 10), all the mines in the Paymaster district are now consolidated into the Whedon Manganese Mines, owned and operated by V. B. Whedon of Beverly Hills.

The production figures for 1941 and 1942, according to Mr. Whedon, are as follows:

Year	Tons	Percent		
		Mn	Fe	SiO_2
1941	198	45.5	0.38	5.0
1942	976	42.0	0.89	8.89

The first shipments were to the U. S. Vanadium Corporation, but most of the 1942 production went to the Metals Reserve stock pile at Phoenix, Arizona. In addition, some 12 carloads of lower-grade ore, containing 21 to 28 percent manganese, were shipped to the Kaiser steel plant at Fontana in the first part of 1943. About half of the latter ore was obtained from dumps left during World War I.

The 1942 production was distributed among three main deposits roughly as follows, by carloads (of a total of 28 carloads): Tolbard, 6 carloads; Moreno shaft, 14 carloads; Whedon drift, 8 carloads.

The first ore shipped by Mr. Whedon came from Tolbard veins No. 1 and No. 2, parts of the Tolbard mine of the last war. These veins run northeast across a canyon, and both were extensively stoped out to the level of the canyon during World War I. On vein No. 1, southeast of No. 2, a pillar of ore was removed on the southwest side of the canyon, and some ore was taken from the bottom of the drift on the northeast side. A vein of good ore 12 to 22 inches thick is now exposed on the floor of this drift near the mouth. From vein No. 2, considerable ore was removed below the floor level in the bottom of the canyon. About 5 carloads were obtained here, from what Mr. Whedon describes as a good vein of solid, high-grade ore. The vein pinched down at a depth of 10 feet below the canyon, but some ore is said to be left. Ore was also obtained from the northeast end of vein No. 2. Work on the Tolbard deposit has been abandoned for the time being.

The Moreno shaft is on a vein which was undeveloped during World War I. It is located between the Tolbard veins and the Tres Amigos vein, in the central part of the Whedon property. About 14 carloads of high-grade ore were obtained here. The vein strikes N. 30° E., and dips 80° SE. It is said to have reached a thickness of 7 feet in the middle, tapering at the top and bottom. Ore was stoped to a depth of 100 feet, according to Whedon, in a vertical and inclined shaft. It was stoped for a length of 90 feet on the surface, tapering downward. The vein splits at the southwest end, a branch running off toward the west. This branch vein has not been developed.

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[3] Hadley, Jarvis B., Manganese deposits in the Paymaster mining district, Imperial County, California: U. S. Geol. Survey Bull. 931-S, 1941.

The Whedon drift is located on the brow of a ridge 150 feet southwest of the Moreno shaft. This vein was likewise undeveloped in World War I. Eight carloads were obtained here, including some of the highest-grade ore shipped. This drift is on a vein that runs off to the northwest from the Moreno vein, and then swings around to the northeast. The tunnel follows the vein for a length of 98 feet. At the mouth of the tunnel is a cross vein, which strikes N. 30° E., and dips 60° NW. The ore stoped was apparently 2 to 3 feet thick. The vein continues on the surface northeast of the end of the tunnel, making a sharp bend at one point.

Another tunnel was driven about 30 feet lower and southwest of the above mentioned drift, along the same vein. The vein here strikes N. 25° E. at the mouth; then splits into two parts corresponding to those at the mouth of the higher tunnel. Ore was stoped out from this drift as well as the higher drift.

A third drift was started from the canyon level, farther to the southwest. The vein is 8 inches thick here. It strikes N. 20° E., and dips 50° NW. This drift is 10 feet long. Short drifts were also started across the canyon to the southwest. One of these is 30 feet long. The ore is 2.5 to 3 feet thick at the mouth, but pinches down at the end. It is of somewhat lower grade than the ore on the northeast side of the canyon. Some high-grade ore was obtained, and some low-grade ore was shipped from here to the Kaiser plant. A shaft is located up the hill 75 feet southwest of the mouth of the tunnel.

INYO COUNTY

No. 1. April Fool (Keegan) Claims. (By F. S. Hudson and R. R. Morse, October 11, 1918.) The April Fool or Keegan claims are 32 miles by road west of Zabriskie, a station on the Tonopah and Tidewater Railway. The owners are Thos. Keegan, J. D. Gray, and Ed Miley. The Manganese No. 1 and No. 4 claims (Inyo 8) are in this area. Their approximate location is sec. 33, T. 21 N., R. 2 E. The claims are reached by following a fair dirt road from Zabriskie to a point 6 miles south of the Carbonate mine, then 2 or 3 miles to the southwest. Water is said to be easily obtainable by drilling along the Amargosa River a few miles east of the prospects. The river is dry during the greater part of the year along this part of its course.

The deposits are a mile north of the north flank of the group of low mountains that lies immediately north of Owl Lake. Here an even piedmont slope is dissected by numerous barrancas. The northerly sloping benches between the barrancas are underlain by a few feet of Recent or Quaternary, unconsolidated desert gravel, whereas the barrancas are cut into the Tertiary deposits lying unconformably beneath the gravels. The Tertiary deposits dip to the southwest at 5° or less.

The most important of the manganese bearing beds in the April Fool claim has a thickness of 18 inches. The ore is very low in specific gravity and may be described as a porous, tuffaceous bog manganese ore. Thin layers of pink clayey material give the ore a decided banded appearance. An assay of the material in place gave manganese 32.2 percent; insoluble, 30.2 percent. An assay of hand sorted material taken from a stock pile ran: manganese, 42.9 percent; insoluble, 14.9 percent.

Tertiary section exposed north of Owl Lake	*Thickness*
a. Well-consolidated conglomerate, having same general characteristics as the conglomerate at the Owl Hole mine.	Unknown
On the "Mn" No. 4 claim (Inyo 8), a 0.5- to 3-foot vein of manganese oxide cuts this conglomerate.	
b. Gap of 125 feet, section concealed by gravels.	
c. Gray and yellow, thin-bedded, spheroidal weathering marl.	10 ft.
d. Sandy gray and brown limestone, platy near the base, more massive above.	6 ft.
e. Fine-grained, dusty, buff-brown sandstone with numerous thin layers of ocherous iron-stained chert. Many veinlets and druses of white opal.	75 ft.
f. Sandy, porous "bog" manganese ore.	1 to 2 ft.
g. Fine-grained gray and buff sandstone (tuff).	25 ft.
h. "High-grade" manganese ore—manganese oxides, principally as matrix in sandstone and as heavy coatings of grains.	1.5 to 2 ft.
i. Fine grained buff and gray tuff with several thin intercalations of ore, similar in character to "h".	20 ft.
j. Late boulder beds unconformably overlying members a to i, and underlying the terrace, sloping gently northward toward the floor of the valley.	

No. 2. Black Dream (Wingate Wash) Deposit. (By Charles B. Hunt, 1941.) The Black Dream deposit is in Wingate Wash, probably in T. 20 N., R. 1 E. It is said to be owned by Roy C. Troeger and leased to Cuddeback, Dorris, and Flaharty of Bakersfield. The ore body is a fissure deposit in a Tertiary conglomerate and sandstone and is broken by many small cross faults. Sooty manganese is found in short lenses throughout a zone 50 to 75 feet wide. Iron oxide and calcite are plentiful. The largest individual lens is 3 feet wide. Many lenses are less than 8 inches in thickness. The average grade is estimated to be 25 percent manganese. The deposit was undeveloped when visited.

No. 3. Campbell Deposit. (From files of U. S. Geological Survey, 1918.) A deposit owned by W. D. Campbell of Bakersfield is reported from Death Valley. The location is unknown. It may be one of the claims in the Owls Head district. Many small fissures less than 1 foot in thickness are found throughout a zone 50 feet wide. The deposit has not been developed.

No. 4. Connard Brothers Claims. (California Min. Bur. Bull. 76, p. 36, 1918.) "The Connard Bros. of New Jersey own 3 manganese claims on the northeast slope of the Panamint Mountains, opposite the south end of Death Valley, and 32 miles west of Zabriskie, a station on the Tonopah and Tidewater Railroad. They are near the old Borax road to Death Valley. The deposit consists of streaks of psilomelane 6″ to 8″ wide on both walls of a bed of calcite striking north and south in rhyolite. A spur vein 2 ft. in width which strikes N. 60 degrees E. and has a dip of 60 degrees, cuts into the main north and south vein at an elevation of 1,000 ft. Only a small amount of development work has been done, but sufficient to show this deposit to be limited to narrow veins from which but little ore could be produced."

No. 5. Death Valley (Manganese Nos. 1 to 6) Claims. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 36, 1918.) The Death Valley or Manganese Nos. 1 to 6 claims are crossed by the old Death Valley Borax road and are located in the immediate vicinity of the Connard Brothers (Inyo 4) claim. The deposit is of the same general character. The owners are E. P. Underwood, L. G. Henderson, and associates of Barstow. On the southwest side of the road are a number of stringers of manganese oxide cutting rhyolite and andesitic breccia. The stringers range from a few inches to 8 inches in width and form a series of parallel veins, which strike N. 50° E. The altitude is 1,400 feet. Of the nine full claims embraced in this property, six called the Manganese Nos. 1, 2, 3, 4, 5, and 6 are on the northwest side of the road. Through these claims extends a series of calcite veins that cut the volcanic rocks. The veins strike N. 50° W., and dip to the northeast. The ore occurs as streaks 6 to 8 inches wide along both walls of these veins. It is high grade psilomelane but the quantity is small.

No. 6. Geronimo Prospect. (By Spangler Ricker, 1942.) A small deposit called the Geronimo prospect is 10 miles east of Olancha, probably in T. 19 S., R. 38 E. Ben Grier of San Pedro is said to be the owner. The deposit consists of low-grade oxide in lava. It has not been developed.

No. 7. Lillie (Mature Consolidated) Mine. (By Ivan F. Wilson, October 17, 1942.) The Lillie mine is on the west slope of the Slate Range in secs. 14, 15, 20, and 21, T. 23 S., R. 43 E. It is 11.1 miles by road north-northeast of Trona; 7.8 miles north along the road toward Ballarat, then 3.3 miles east along an unimproved dirt road. The nearest shipping point is Trona on the Trona Railroad. The mine is on the side of a canyon on a steep south slope at an elevation of 3,000 feet. This canyon heads near B. M. 3927 on the Searles Lake quadrangle.

A claim notice states that Lillie Claim No. 1 was recorded July 8, 1937 by Harold Chappelle of Bakersfield. This is probably the claim known during the last war as Mature Consolidated owned by F. W. Chappelle and L. B. Crow. The property was idle when visited, and appeared to have been for some time.

Most of the development on the property was for gold, silver, and perhaps copper. A long tunnel has been driven into the slope starting from near the bottom of the canyon. The only manganese development consists of a few small shallow cuts. The largest of these is an L-shaped cut, 3 feet wide and as much as 12 feet deep at the face, extending northward into the hill across the strike, and eastward following the strike, about 20 feet in both directions.

The manganese ore is in a series of metamorphosed sedimentary rocks on the hanging wall of an intrusive granite. The bottom of the canyon is granite and its upper contact occurs about a third of the way up the slope to the north. Irregular shaped apophyses of granite and several quartz veins extend into the metamorphic rocks. The metamorphic series includes two belts of gray crystalline limestone or marble. These strike east and dip 30° N.

The manganese occurs in a gossan zone in irregular areas, mostly at the footwall of the limestone. The gossan includes manganese and iron oxides, accompanied by brown jasper and quartz vein material, and in places by sulphur and gypsum. In the upper limestone is one gossan area about 20 by 20 feet, and some other masses 1 foot to 3 feet thick and 20 to 30 feet long along the footwall. Much of the manganese in these areas is in the form of crusts or stains. The lower limestone contains at the footwall a gossan zone 2 to 3 feet thick exposed for 30 feet in the L-shaped cut mentioned. Another zone 20 feet long crops out 70 feet to the west.

In addition, thin veinlets of oxidized material 2 to 3 inches thick lie in the limestone.

Microscopic studies in 1918 showed that the manganese oxides are derived from a gedrite rock associated with anthophyllite, and from a garnet rock occurring in a quartz-garnet-amphibole rock enclosing the limestone bodies. It was concluded that the manganese might be a metamorphosed sedimentary bed, and that the quartz-garnet-amphibole rock represents altered siliceous sediments.

About 20 tons of ore has been piled on the dump at the bottom of the canyon. It includes psilomelane, in part botryoidal, pyrolusite, iron oxides, and unoxidized pyroxene (?). The grade is estimated to be between 20 and 30 percent manganese. Assays from previous investigations showed 28 percent manganese, 14 percent iron, and 23 percent silica.

No. 8. Manganese No. 1 and No. 4 Claims. (By F. S. Hudson and R. R. Morse, October 11, 1918.) The Manganese No. 1 and No. 4 claims are a quarter of a mile southeast and three-eighths of a mile east, respectively, of the April Fool deposit (Inyo 1). They are in sec. 33, T. 21 N., R. 2 E. and are owned by Thomas Keegan, J. D. Gray, and Ed Miley of Tecopa. The claims are undeveloped.

The deposits consist of impure bedded manganese oxide in a series of sandstone and conglomerate. In the No. 1 claim the maximum thickness of the ore bed is 30 inches, of which the upper 8 inches is the richest. A sample across the entire thickness of 30 inches contained 20 percent manganese and more than 40 percent silica.

In the No. 4 claim, the sediments are cut by a vein of hard, metallic, black oxide carrying scattered boulders of waste rock. This vein strikes N. 60° W., and dips steeply toward the north. It ranges in thickness from 0.5 foot to 3 feet and is exposed for a distance of 25 feet. The manganese oxide appears to be of good grade, but the deposit had not been developed when visited.

No. 9. Orr Claim. (From files of U. S. Geological Survey, 1942.) A deposit owned by Frank W. Orr of Bakersfield is 40 miles from Shoshone, probably in T. 20 N., R. 1 E. It may be in the same area as the War Baby deposit of Wingate Wash (Inyo 11). If so it probably is a bedded deposit low in manganese.

No. 10. Runge Claim. (From files of U. S. Geological Survey, 1918.) A deposit, said to be owned by Chris Runge of Keeler, is in T. 18 S., R. 38 E., 8 miles south of Keeler and 1 mile west of the road to Darwin. About 6 tons of ore is said to have been mined but the grade was too low to ship.

No. 11. War Baby (Wingate Wash) Deposit. (By C. B. Hunt, 1941.) The War Baby deposit is in the Wingate Wash, in T. 20 N., R. 1 E., in the same general area as the Black Dream deposit (Inyo 2). It is said to be leased to Cuddeback, Dorris and Flaharty of Bakersfield. The ore body consists of bedded manganese oxide in conglomerate and sandstone, in contrast with the Black Dream deposit which is a fissure deposit. Three beds of manganese are found in a zone 10 to 12 feet thick. The grade is low, probably not over 5 percent manganese.

KERN COUNTY

No. 1. Apache Claim. (By Spangler Ricker, 1942.) The Apache claim is 5 miles west of Garlock, probably in T. 29 S., R. 38 E. It is said to be owned by Richard Hamilton of Randsburg. The ore consists of a replacement of oxide in limestone. The grade is low. Assays give 0.6 percent manganese and 2.8 percent iron.

No. 2. Big Indian Claim. (From files of U. S. Geological Survey, 1918.) The Big Indian claim is 3 miles west of Atolia, probably in T. 30 S., R. 40 E. The owner is reported to be W. W. King of Johannesburg. The ore body is 3 feet in width and the primary ore mineral is said to be rhodonite.

No. 3. Culbert Brothers Claim. (By F. S. Hudson, September 21, 1918.) Siliceous oxide ore has been found as float in the NE¼NW¼ and NE¼NE¼ sec. 10, T. 30 S., R. 40 E., on a gold claim operated by Culbert Brothers of Randsburg. Because of the low grade, no effort has been made to find ore in place.

No. 4. Exposed Treasure Deposit. (Condensed from original description in Am. Inst. Min. Met. Eng. Trans., vol. 38, pp. 310-319, 1907.) The Exposed Treasure deposit is in sec. 19 or 20, T. 11 N., R. 12 W., 2.5 miles south of Mojave. The property was originally worked for gold and silver. The ore bodies are associated with fault zones in rhyolite porphyry. Three successive periods of faulting are reported. Metallic sulphides and silica are deposited in deeper zones and calcite impregnated with iron and manganese oxides in upper zones. Near the surface the carbonate has been leached leaving residually enriched deposits of manganese and iron in a matrix of silica. The property has produced no manganese.

No. 5. Manganese Queen Mine. (By F. S. Hudson, September 21, 1918.) The Manganese Queen mine is on a claim located by Leidy & Harris, and now owned by E. J. Emmons of Bakersfield. It is in the SE¼ sec. 16, T. 30 S., R. 40 E., and lies 6 miles by road west of Atolia, on the Randsburg branch of the Santa Fe Railroad. The altitude is 4,000 feet.

An incline has been sunk 10 feet along a 3.5-foot layer of manganese bearing quartzite, which strikes N. 30° E., and dips 50° S. The footwall and hanging wall are of quartz-mica schist. The better ore occurs as pockets in the more siliceous material. No primary ore has yet been uncovered, the ore consisting of an intimate mixture of black oxide and silica, in varying proportions. Some 27 tons of ore, high in silica, has been mined; also 4 tons of carefully sorted material containing 43 percent manganese and 23.8 percent insoluble.

The upper working is 200 yards N. 10° E. from the main working. A trench has been made for 75 feet along the outcrop of a ledge which strikes N. 37° W., and dips 70° W. Banded quartz-rhodonite-garnet rock was encountered at a few feet in depth, and the working has been abandoned owing to failure to find any low silica ore.

No. 6. Midlothian Mine. (By F. S. Hudson, September 21, 1918.) The Midlothian mine is in the SE¼ sec. 12, T. 30 S., R. 39 E., at an altitude of 2,900 feet, 7 miles southwest of Randsburg by road. The owner is M. J. Lovett of Randsburg. A small amount of work has been done on a manganiferous quartzite bed enclosed in the schist. The bed is offset by faulting in such a manner that the northern part dips 75° W., whereas the southern part dips 55° SW. The material of highest manganese content occurs on the two walls of the quartzite layer. The ore is black oxide, carrying silica not only finely intermixed, but also as iron stained skeletons that are free from manganese. Five tons of ore have been sorted out from 20 tons that has been mined. This sorted material contains 32 percent manganese and 43.4 percent insoluble.

No. 7. O. K. (Keough) Claim. (By Ivan F. Wilson, November 7, 1942.) The O. K. or Keough claim is on the Walker Pass road at the southern end of the Sierra Nevada, on the south fork of the Kern River. It is probably in sec. 27, T. 26 S., R. 34 E. It is reached by proceeding along the main road east of Isabella for 5.1 miles, then turning southeast along a dirt road for an additional 3.6 miles. The nearest rail point is 56 miles west at Bakersfield. The claim was located April 14, 1935, by F. F. Keough and H. R. McAllister of Taft.

A shaft 30 feet deep has been sunk on top of a hill, and the only exposures of manganese ore are in this shaft. The shaft reveals a bed of manganese ore 3 feet thick at the top of the shaft, 2 feet wide at a depth of 10 feet, and 5 feet wide at the bottom. The bed is enclosed in a highly quartzose quartz-mica schist, which strikes N. 45° W., and dips 60° SW. at the top of the shaft. The dip is nearly vertical at the bottom. Some faulting is evident in the shaft as a gouge zone lies parallel to the ore body.

Quartz-mica schist crops out in the vicinity, and a belt of gray coarsely crystalline limestone is intercalated with it to the northwest. These metamorphic rocks are probably roof pendants in granitic rock, which cover most of the Sierra Nevada in this region. There are no exposures immediately northwest and southeast of the shaft, and it is reasonable to suppose that the manganese ore bed extends for some distance in each direction.

The manganese ore exposed in the shaft is partly in the form of oxidized rhodonite. Individual crystals 3 inches in diameter were noted, and many are an inch thick. These crystals have been oxidized to such an extent they are black, but upon fresh fracture pink spots of the original rhodonite may be seen. The pyroxene cleavage is retained.

In the shaft, zones of the coarsely crystalline oxidized rhodonite alternate with zones of a soft, light, crumbly, black oxide ore, in places stained brownish by iron oxides. This soft ore is low grade. It also probably formed from rhodonite, and may represent zones of greater fracturing where oxidation was able to proceed more rapidly. Both the rhodonite and the oxide extend from the top to the bottom of the shaft. A composite sample across the bed at the bottom of the shaft, including the partly oxidized rhodonite as well as the soft black oxide, ran 20.15 percent manganese.

At the top of the shaft is gray quartzite with pockets of manganese oxides. This rock resembles the metamorphosed chert of the Calaveras formation farther north, and it is thought that this deposit may be a metamorphosed bedded deposit.

No. 8. Shamrock No. 2 Claim. (By Ivan F. Wilson, October 18, 1942.) A manganese claim known as "Shamrock No. 2" is 2 miles by road north of Randsburg. It is probably in sec. 26, T. 29 S., R. 40 E. A claim notice dated November 20, 1935, and signed by Capt. R. H. Dymond, E. R. Taber, Jack Boatwright, and M. J. Meadows was found. The property was idle when visited, and there was no indication of recent work. The nearest rail point is 4 miles northwest at Rand on the Southern Pacific Railroad.

Development consists of a small shaft 15 feet deep and a drift 20 feet long. A bed of quartzite 1 foot to 2 feet thick is exposed in the shaft and on the surface for a length of 20 feet. This quartzite seems to be a metamorphosed chert. Pockets of manganese oxide are enclosed in the quartzite. A very small amount of the rock is high grade, but most of it contains more quartz than manganese. The average grade is estimated to be 20 percent manganese. No primary manganese minerals were noted, but analogous deposits have developed mainly from rhodonite. The quartzite bed and enclosing schist strike N. 50° W., and dip 30° NE.

No. 9. Snowy No. 1 (Cuddy) Claim. (By Ivan F. Wilson, November 5, 1942.) The Snowy No. 1 claim is on Neason Ridge west of Lebec, in the mountainous region at the head of Pleito Creek. It is in the Mt. Pinos quadrangle in the Los Padres National Forest, probably in sec. 12, T. 9 N., R. 21 W. The property is reached by driving west from Lebec along the road through Frazier Park into Cuddy Valley for 13 miles, then turning north along a Forest Service dirt road, signed ''Neason Ridge Trail,'' for 1.6 miles to the top of the ridge and end of the road. From here a trail is taken toward the west for 350 feet, thence a branch to the north for 3 miles along the ridge to its end in a saddle. One deposit is on the southwest slope 850 feet below the top of the ridge and another is 400 feet farther down the slope. The total distance from Lebec is 17.5 miles (14.5 by road, 3 by trail). The nearest rail point is 53.5 miles southeast at Saugus on the Southern Pacific Railroad. The owner of the claim is R. C. Cuddy.

Siliceous manganiferous rock enclosed in a highly quartzose coarse-grained quartz-mica schist is found over a fairly large area. Granitic rocks underlie most of this area. A few exposures of schist and marble are found on the property. They presumably are roof pendants in the granite. The schist has variable attitudes, but the general strike is northeast and the dip is steep to the southeast.

The exact nature of the manganiferous rock is uncertain. It consists largely of manganese stained quartz. It may be a silicified part of the schist, or it originally may have been a quartzite which was cut by quartz veins. Manganese oxide thoroughly stains a large thickness of silicified rock, and more or less penetrates the rock. It is mostly hard psilomelane, but some soft black oxide also occurs. In places limonite stains are found. No primary manganese minerals were seen.

The manganiferous rock covers one area 250 feet long and 40 feet wide in the southern part of the property. At the south end is an open cut 15 feet long, 3 feet wide, and 6 feet deep. Another small cut lies 30 feet northwest. Manganese stained rock is exposed continuously between these two cuts. The boundaries on each side are indefinite. A composite sample across the entire 40 feet contained 3.34 percent manganese.

The first mentioned cut is in a canyon trending southwestward and the manganiferous rock is not exposed south of this canyon. To the south are exposures of schist and marble. The manganiferous zone is possibly truncated by a fault roughly parallel to the canyon. Fault gouge is exposed in the face of the cut in the canyon.

A second cut lies at the east edge of the manganiferous zone, 150 feet northeast of the first cut. This cut is 12 feet long, 3 feet wide, and 6 feet deep. It trends N. 50° W. The manganiferous rock exposed is of a higher grade than in the first cut. The ore body is 12 feet wide and 50 feet long. A sample taken across the 12-foot zone contained 12.98 percent manganese. Lower-grade material extends west of the second cut for a total thickness of 50 feet.

About 125 feet north of the second cut is a third cut which exposes a manganiferous rock that is probably not continuous with the large area previously mentioned. This third cut is 15 feet long, 4 feet wide, and 6 feet deep. The attitude and boundaries of the manganiferous zone are uncertain, but the thickness is at least 5 feet. The grade is similar to that of the second cut. Two small outcrops of manganiferous rock occur up the hill to the north, 30 feet and 70 feet, respectively, from cut No. 2. Beyond this to the north is float of marble, schist, and granite.

No. 10. Walsh and McClaude Claim. (From files of U. S. Geological Survey, 1942.) The Walsh and McClaude claim is said to be located in T. 28 S., R. 39 E., 8 miles west of Garlock. The owner is W. J. Walsh.

LAKE COUNTY

No. 1. Arroyo Lobo Claim. (By E. F. Davis, July 13, 1918.) The Arroyo Lobo claim is owned by Charles R. Dow of Lower Lake. It is in the NE¼ sec. 3, T. 14 N., R. 7 W., and is 4 miles northwest of Arabella schoolhouse. It is 40 miles to Calistoga via Lower Lake and Middletown.

The manganese deposit is northwest of the Dow Ranch in a large area of radiolarian chert. At the place where the ore is found are two zones of massive chert stained with manganese oxide. These zones strike N. 30° W. and are nearly vertical. They are enclosed in, and conformable with, thin-bedded red and gray chert. They may be traced 1,000 feet down the hill to the south.

At several places along the course of these chert zones are exposures of siliceous black oxide ore. The westerly zone shows the largest amount of ore. In one place a short tunnel was driven years ago in an attempt to find silver beneath the outcrop of manganese. The material exposed here is a black oxide containing cores and skeletons of porous silica and also streaks and bands of compact jaspery silica. It is cut by veins of quartz. The thickness of the ore bed ranges from 2 to 4 feet and the exposures have a total length of 75 feet. The average grade is estimated to be 30 percent manganese and 30 percent silica.

No. 2. Bell Deposit. (From Files of U. S. Geological Survey, 1918.) The Bell deposit is in sec. 31, T. 12 N., R. 5 W., in Morgan Valley near Lower Lake. It consists of opaline iron manganese ore. The grade is reported as low.

No. 3. Black Point Claim. (By E. F. Davis, July 21, 1918.) The Black Point claim was located by M. Walter Clark of Cobb Valley, upon an abandoned prospect tunnel said to have been driven years ago in search of silver ore. No development has been done recently. The prospect lies in sec. 21, T. 11 N., R. 8 W., on the west side of Cobb Mountain. It is 3 miles from the Calistoga-Kelseyville road and 31 miles from Calistoga. It is within 0.3 mile of an old road to a sawmill on the west side of Cobb Mountain.

The country rock is mainly thin-bedded, red radiolarian chert. In the immediate vicinity of the prospect, the chert is discolored by stains and films of black manganese oxide. The ore occurs as pockets and small lenses in a thick bed of massive chert. The more siliceous parts of the ore bed form bold outcrops. The ore bed is exposed in the old prospect tunnel, which is now caved. At the upper surface the contact of the ore is essentially parallel to the bedding of the enclosing chert, although the contact is not sharply defined. The ore body can be traced for 300 feet. It shows a rude banding in its upper part. The best ore occurs in pockets and lenses. A sample of a high-grade lens contained 42.2 percent manganese, 18.4 percent silica, and 10.4 percent available oxygen.

No. 4. The Black Powder Claim. (By E. F. Davis, July 15, 1918.) The Black Powder claim was located by T. M. Smith of Lower Lake. It is in the NW¼NE¼ sec. 31, T. 12 N., R. 5 W., 1.5 miles southwest from Frank Ebenhauser's Ranch at the base of a high point composed of greenstone of the Franciscan group, locally known as Butte Rock or Shaly Cliff. Motor trucks could come within a mile of this deposit if a road 0.5 mile long were built. It is then 45 miles to Winters by wagon road.

The ore zone consists of a series of manganiferous beds having a total thickness of 25 feet and exposed over a length of 30 feet along the strike. A section in a creek at the northwest end of the ore zone exposes the beds for a length of 20 feet along their dip. The beds strike nearly northwest and dip 40° NE. The lower and middle parts of the ore zone consist of soft red, rather impure iron oxide mixed with layers of opaline iron manganese ore. The impure iron oxide, or "paint rock," is bright red to red brown in color, is soft and crushes easily to a fine powder. The opaline iron manganese ore is brittle, has a hardness of 3 to 4, and breaks with a smooth curving fracture. Both the opaline iron manganese and the soft impure iron oxide contain considerable manganese, shown by the fact that on exposure to the air they become coated with films of black manganese oxide. A peculiar feature of this deposit is beds of nodular green chert which have a maximum thickness of 2 feet. The nodules in this chert are ellipsoidal masses of manganese which have the plane of longer dimension parallel to the bedding. Some nodules are 6 inches in length and 1.5 inches thick. These nodules may be separated easily from the matrix. When removed they are cracked as though they had shrunk. The oxide in the nodules shows a granular texture, the grains being 0.2 to 0.5 millimeter in diameter. On striking a nodule with a hammer one gets the peculiar impression that the nodule is plastic. This is probably due to the interlocking of the grains of oxide that compose the nodule. Some of the nodules show a peculiar concentric banding due to thin films of extremely fine textured manganese oxide running through the otherwise granular material.

In the central parts of the larger nodules are cores composed of interlocking grains of a yellowish-green mineral with a bright vitreous luster. This mineral is probably a silicate of manganese, since all transitions may be found between the fresh mineral and the soft but granular manganese oxide. Little regularity is seen in the distribution of manganese nodules and the bodies of chert. They may occur at any horizon in the shaly matrix. Also, the manganese nodules are not limited to one zone and the chert lenses to another. The bodies of different material may lie anywhere in the enclosing matrix. The only regularity observable in their arrangement is that the planes of longer dimensions are parallel to the bedding of the lower parts of the ore zone.

The ore zone is enclosed in greenstone of the Franciscan group, but the relations of the ore to the greenstone are not clear. The ore ends abruptly at the creek, and no manganiferous rocks are found on the northwest side of the creek. The places in the creek where the base and top of the ore zone would be expected are covered with boulders.

The nodules of manganese oxide now exposed in the upper part of the ore zone are small in number. The material is a new variety of manganese ore in this region and it is, therefore, impossible to speak with certainty about it until analyses are at hand and the minerals are determined in the laboratory. It is not possible to predict what changes may occur in depth, though it seems certain the primary manganese mineral is a silicate.

In sec. 30, about 1,000 feet northeast of the Black Powder outcrop, a siliceous iron ore contains a little manganese. It is too low in manganese and too high in silica to have any value, though the amount present apparently is large.

No. 5. Cobb Mountain (Oyster Rock) Prospect. (By E. F. Davis, July 21, 1918.) W. A. McCombs and George Hill, both of Middletown, have a prospect on the west side of Cobb Mountain near the Lake County line, probably in sec. 21, T. 11 N., R. 8 W. The location notice and prospect pit are 250 feet southwest of Geyser Rock, a large rock that stands near the county line. The prospect lies 3.5 miles from the Middletown-Kelseyville road and is 30 miles from Calistoga.

A mass of greenstone is exposed in a cut. This greenstone contains inclusions of jasper that have been metamorphosed by the heat of the intrusion. The fractures and cracks in the greenstone and jasper are stained black with manganese oxide. Fresh breaks are free from manganese oxide and the total amount of manganese here is small.

No. 6. Coleman Prospect. (By E. F. Davis and F. S. Hudson, August 13, 1917.) The Coleman prospect is in sec. 29, T. 12 N., R. 9 W. It lies about 3 miles west of Cobb Post Office and 2 miles west of Coleman's Ranch. A road from the ranch crosses the creek at the southeast end of the property. The owners are J. H. Coleman of Cobb, and J. D. Sullivan of Kelseyville.

A body of massive metamorphosed red and vermilion chert, 20 to 50 feet thick, runs along High Valley Creek, trending northwest, and may be traced for 1,300 to 1,400 feet along the strike. This chert is stained on fracture planes by manganese oxide. Shearing along these fractures has developed "mirrors" of manganese oxide. In places the chert passes into a fair grade of ore but no workable body has yet been uncovered.

A smaller body of chert containing manganese is exposed at a point 1.3 miles downstream. It is of the same nature as the larger body.

No. 7. Copsey and Moore Prospect. (By E. F. Davis, July 5, 1918.) Arthur Copsey and W. P. Moore of Middletown have a manganese prospect in sec. 33, T. 12 N., R. 2 W. The ore crops out in an area of serpentine and lies within a few feet of an exposure of greenstone of the Franciscan group. The relation of the ore to the igneous rocks is not apparent. The manganese ore is black and hard. Apparently it is a manganiferous chert and too siliceous to have value as a source of manganese.

No. 8. Dow Prospect. (By Frank S. Simons and Max D. Crittenden, Jr., July 25, 1942.) The Dow prospect is in sec. 4, T. 14 N., R. 7 W., on land owned by Carol Dow of Lower Lake. The prospect is 2 miles by trail from the Dow Ranch, which is 6 miles by a good gravel road from the Williams-Clear Lake road and 36 miles from Williams, the nearest railroad point. The prospect is 600 feet above the bottom of Quartz Canyon, a tributary of Wolf Creek. A road could be built to it rather easily. Little development has been done.

The Dow prospect is on a ridge composed of thin-bedded red chert and siliceous shale, with some thick bands of sandstone lying between chert areas. The ore bed can be traced more or less continuously for 140 feet along the strike. The hanging wall, where exposed, is white chert overlain by sandstone; the footwall is white chert with some interbedded shale, and is underlain by platy red chert. The maximum thickness of ore exposed is 3 feet near the middle of the outcrop, and the maximum depth of exploration is 2 feet. The ore appears to be irregularly distributed along the strike of the ore bed. The strike varies from N. 55°-80° W., and the dip from 45° to 50° SW.

The ore thus far exposed is soft black pyrolusite, containing cores of white to reddish brown leached chert. The best ore contains about 45 percent manganese; the average grade is nearly 35 percent. The silica content is 20 to 30 percent. The surface ore is cut by many thin quartz veins, which cause the otherwise soft ore to make resistant ridges.

No. 9. Downey Estate Prospect. (By Max D. Crittenden, Jr., August 5, 1942.) The Downey Estate prospect is in the NW¼ sec. 8, T. 10 N., R. 7 W., on the road from Middletown to the Helen mine, 0.1 mile west of the road to the Von Glahn Ranch, and about 3 miles from Middletown on land of the Downey Estate.

The country rock is thin-bedded red chert, striking N. 60° W. and dipping steeply northeast. A 3-foot bed of manganese ore is exposed in the edge of the creek, but the lack of development precludes estimation as to possible length or continuity. The ore consists of a smoothly rounded surface of dull black oxide, but whether this is merely a coating due to leaching of manganese, or whether it represents an actual bed of workable ore, is unknown. The average grade is thought to be 40 percent manganese. About 2 tons of such ore is exposed.

No. 10. Ebenhauser Prospect. (By E. F. Davis, June 13, 1918.) Frank Ebenhauser of Rieff has a manganese prospect in the SW¼ sec. 20, T. 12 N., R. 5 W. It is on the road from Monticello to Lower Lake, 25 miles from Monticello and 18 miles from Rumsey. The prospect is on the main road 0.5 mile east of the house. The material exposed is opaline iron manganese ore containing less than 10 percent manganese. Associated with this ore are lenses of a yellow, rather porous chert, together with some lenses of red compact jasper. A fine-grained greenstone is exposed at several points within a few feet of the ore bed, but it was not possible to determine the relationships. At one point an old tunnel runs into the ore for a few feet. About 250 tons of this opaline iron manganese ore is present.

Nô. 11. Elliott Prospect. (By Frank S. Simons and Max D. Crittenden, Jr., July 24, 1942.) The Elliott prospect is in sec. 25 or 26, T. 12 N., R. 9 W., near the county boundary point common to Lake, Mendocino, and Sonoma Counties. The prospect is on government land controlled by Frank Elliott of Whispering Pines, and is leased to the Strategic Minerals Company, Ltd., of San Francisco. The prospect is 3.8 miles from the Cobb-Kelseyville road, 6.8 miles from Cobb, and 43 miles north of Santa Rosa, the nearest railroad point. Water is available a few hundred feet from the prospect.

An open cut 300 feet long exposes massive, sheared and slickensided, manganiferous brown chert. The face exposed is 30 feet high. The attitude of the chert is concealed by faulting but it is about northwest in strike. Greenstone forms the southwest wall at the southeast end of the cut. At the northwest end, the chert is faulted against a fresh porphyritic greenstone. The strike is N. 45° W., and the dip 35° NE. The fault is vertical and strikes N. 80° W.

The ore found thus far consists mainly of manganiferous chert, containing 5 to 10 percent manganese, and 60 percent silica. Small amounts of hard blue psilomelane and soft black pyrolusite are present, but these oxides usually are in thin seams and along shear zones. The ore zone is at least 20 feet thick, and can be traced intermittently for 0.5 mile southeast along the strike. At no place, however, is anything but manganiferous chert exposed.

No. 12. Gravelly Valley Deposit. (By Max D. Crittenden, Jr., October 6, 1942.) The Gravelly Valley deposit is near the center of sec. 3, T. 18 N., R. 10 W. The nearest shipping point is Ukiah, a distance of 35 miles. The Gravelly Valley mine is owned by Ed George and the McCullough brothers. At the time the mine was examined, a bulldozer was on the property ready to begin construction of an access road. The work at the property consists of two adits and a number of open pits and prospect holes.

The Gravelly Valley mine is in an intensely folded and sheared area of chert and sandstone of the Franciscan group. The general trend of the beds seems to be N. 60° W., parallel to the ravine in which they lie. Small scale faulting is common, and has produced many local brecciated areas. Manganiferous beds, originally present in the chert, have been sheared and broken by this deformation, and are thus especially susceptible to the leaching and oxidizing action of surface water. The result has been the formation of friable, medium-grade oxide ores in locally brecciated areas, from primary material that appears to have been manganiferous chert, hydrous manganese silicates, or disseminated manganese carbonate. The grade of the primary ore is thought to have been 20 to 30 percent manganese. The ore exposed is friable black oxide, with powdery and ocherous cores representing the original cherty or siliceous parts of the primary ore.

This ore has been exposed at several places, only three of which appear to hold promise. These are along the northern side of a ravine that trends N. 30° W., and slopes toward the upper end of Lake Pillsbury. The horizontal linear distance between the outermost exposures is probably 150 feet. There is but one intermediate exposure of ore, and in detail, the bodies that have been followed in the development work appear to be lenticular faulted masses.

No. 13. The Hermann Claims. (By E. F. Davis, June 8, 1918.) Henry Hermann of Middleton has located several claims on bodies of manganiferous iron ore near the Hermann Ranch on Bucksnort Creek, 11 miles east of Middletown. The Hermann claim is near the center of sec. 20, T. 11 N., R. 5 W., 1.5 mile northeast of the Hermann Ranch. A shallow trench has been sunk on an outcrop of massive manganese-stained jasper. The trench exposes a little siliceous iron ore carrying small amounts of manganese. A sample taken here gave 6.1 percent manganese, 52.0 percent iron and 18.3 percent silica.

No. 14. Herndon (Manganese No. 1) Claim. (By E. F. Davis, July 2, 1918.) The Herndon claim was located by N. W. Herndon of Lower Lake. It is in sec. 22, T. 14 N., R. 6 W. It is reached from Lower Lake by going 10 miles east on the Sulphur Creek road from Lower

Lake to Williams, to the north fork of Cache Creek, then following the north fork of Cache Creek to Ben Moore Canyon, and up Ben Moore Canyon to the Old Herndon sheep camp 13 miles from Lower Lake. The claim lies east of the old camp, 0.8 mile from the summit of the ridge on the east side of Ben Moore Canyon. If ore were hauled from this claim it could be brought down in a wagon, with a little brush cutting, to Ben Moore Creek. With a small amount of work a road could be built down this creek joining the road along Cache Creek. The total distance from the railroad at Calistoga is 46 miles. The work on this property consists of a single trench 20 feet long.

The ore occurs in a body of radiolarian chert of the Franciscan group which dips 45° N., and strikes N. 60° W. The total thickness of the ore and the radiolarian chert is 25 feet. The beds of ore and the chert are parallel throughout the section. The chert is bounded on the north by greenstone. The geologic relations between the chert and the greenstone are not clear. Near the base of the exposed section of radiolarian chert is a massive bed of red chert containing curving veinlets of white quartz. In some places this type of quartz veining is in radiolarian chert found near the contact with intrusive basalt of the Franciscan. With this exception, there is no evidence of intrusion or metamorphism of the chert by the greenstone. The radiolarian chert and manganese ore beds are cut by small faults which render the sequence uncertain.

The radiolarian chert is deep brick red. In part it is massive; in part thin-bedded. The aggregate thickness is 10 feet. Where thin-bedded, the chert is generally separated by thin partings of soft red impure iron oxide (paint rock). The aggregate thickness of iron oxide beds is 5 feet.

Green chert beds with a granular texture are also present. These beds range from 2 to 4 inches in thickness and are separated by partings of impure red iron oxide. They have a total thickness of 3 feet. One 6-inch bed appears within a zone of massive green chert and red iron oxide partings. It is laminated, the laminae being about one-eighth inch in thickness and consisting of bands of a dark steel-gray to black mineral and of siliceous yellow limonite. The dark-colored mineral is crystallized in minute grains. Its streak is dark red, and it was determined in the field as hematite. In a few places it appeared to be mixed with psilomelane.

About 7 feet of the exposed section is composed of opaline iron manganese ore. This ore is generally massive and does not show the tendency to thin bedding exhibited by the associated cherts. It has a hardness of about 4, and is brittle, crushing easily to a dark brown to red powder; and on fresh fractures shows a brilliant waxy luster. The color varies with the proportion of iron and manganese in the opal. Some varieties are bright cherry red. These show no change on exposure to the weather. Others are pale chocolate brown to reddish brown. On exposure to the weather these varieties become quickly coated with a film of black manganese oxide. The red-brown variety may show a tendency to spherulitic structure. On examining it with a hand lens, spots of light-brown color, nearly circular in outline, may be distinguished in a matrix of darker material. In a few places thin partings of red-brown opaline material form the parting between thin beds of bright-red chert containing numerous radiolarian skeletons. A considerable amount of the granular hematite in laminated form is exposed in an open pit 100 feet west of the main ore body.

No. 15. Herrick Prospect. (By E. F. Davis and F. S. Hudson, August 10, 1917.) The Herrick prospect is in the SE¼SE¼ sec. 25, T. 11 N., R. 8 W., about 3 miles west of Middletown. The owner is S. B. Herrick of Middletown. The ore body is a massive bed, 3 feet in thickness, enclosed in well-bedded red chert, and lying parallel to the bedding. It has been exposed by a small open cut. Greenstone is seen in contact with the enclosing chert 120 feet north of the open cut. Apart from a few small pockets, the ore body is siliceous, consisting mostly of original massive jasper, veined by quartz and cut by thin veinlets of manganese oxide. The local pockets of manganese oxide are rendered worthless by numerous quartz veins.

The bed of the creek, which flows to the northwest passing a few yards to the south of the prospect, is full of boulders and pebbles of red chert. Fifty yards upstream from the manganese prospect a 6-inch boulder of soft rich manganese ore was found. Farther upstream several boulders of low-grade ore were seen. From the amount of float in the creek it is thought that a large body of red chert is here, and the presence of many fragments of manganese ore in the creek probably indicates the existence of a considerable body of ore within this drainage area.

No. 16. La Bree (Manganese No. 2) Claim. (By E. F. Davis, July 12, 1918.) The La Bree claim was located by Jack La Bree of Lower Lake. A location notice was afterward put on it by J. H. Bigelow of St. Helena, but no work was done on it by him. Only a small amount of work was done by the original discoverer. This consisted in digging a few shallow pits. The claim is in sec. 22, T. 14 N., R. 6 W., and adjoins the claim located by N. W. Herndon and known as the Herndon or Manganese No. 1 (Lake 14) claim. It is 46 miles from Calistoga.

The relations here are much the same as those on the Herndon claim. In fact La Bree's claim lies just 750 feet west of Herndon's claim and appears to be on a continuation of the same body of radiolarian chert. The chert is bounded by greenstone. The relations of greenstone to the chert are not determinable. The chert is thin-bedded and is separated by partings of impure red iron oxide. There are also several exposures of green and yellow chert, rather massive in structure, and containing much crystalline quartz. A few thin beds of fine-grained hematite banded with siliceous yellow ocher are also present. In some of this material are bands of psilomelane.

No. 17. Little Falls Deposit. (By Max D. Crittenden, Jr., August 6, 1942.) The Little Falls deposit is in sec. 25, T. 12 N., R. 9 W., and is owned by James Gunn, Jr., of Kelseyville. It is 0.5 mile from the road along Kelsey Creek. Red thick-bedded chert, locally sheared, with dark shaly material along the sheer planes, shows manganese-stained joint surfaces over a considerable area. Bedding is obscure, and the strike is highly variable. Small quantities of ore appear on or near the surface due to surface concentration. Small pieces can be found that contain 30 percent manganese, but most is well under 10 percent.

No. 18. M. & G. Claim. (By E. F. Davis, July 13, 1918.) The M. & G. claim was located by Jack La Bree of Lower Lake. It is in sec. 34, T. 14 N., R. 7 W., and is 8.8 miles north of Lower Lake, and 43 miles from Calistoga. The deposit is 0.2 mile from the Lower Lake-Arabella road. An open cut has been opened into the hillside for a distance of 15 feet.

The ore body is underlain by thin-bedded, ash-colored chert of somewhat porous texture separated by thin partings of black oxide of manganese. It is overlain by thin-bedded white chert containing only a trace of manganese. The ore body lies parallel to the bedding of the enclosing chert. The dip of these beds is 30° S., a little lower than the angle of the hill slope here; the strike is N. 75° W. The ore body is 2 feet thick and is low in manganese and high in silica.

No. 19. Mead Prospect. (By Frank S. Simons and Max D. Crittenden, Jr., July 24, 1942.) The Mead prospect is on land owned by Ray Mead of Middletown in sec. 35, T. 11 N., R. 8 W., on the ridge between Bear Canyon and Gunning Creeks. It is 5 miles by road and 1 mile by trail northwest of Middletown, and 20 miles north-northeast of Calistoga, the nearest railroad point. The area is heavily soil covered. On the crest of a small ridge is an outcrop of manganiferous chert striking east and dipping 50° S. One hundred feet below the ridge and scattered along the creek bottom for several hundred feet are numerous blocks of the same rock, some weighing 500 pounds. Manganiferous chert crops out at only one place; so the strike, length, and thickness are unknown. The best ore is a soft black manganese oxide containing about 35 percent manganese. The amount of this ore is small, and the average grade of all ore in sight is probably 15 percent manganese. Most of the ore is siliceous and is cut by numerous small quartz veins. The oxides form thin films along fractures.

No. 20. Myers (Red Bay) Prospect. (By E. F. Davis, July 5, 1918.) The Ben F. Myers or Red Bay prospect is 1 mile from the road between Clear Lake and Williams, 35 miles from Williams in sec. 35, T. 13 N., R. 6 W. This property was not visited but from Mr. Myers' description of the ore the deposit is chiefly composed of low-grade, opaline iron manganese ore. The best ore according to Mr. Myers contained 12 percent manganese and 60 percent iron.

No. 21. Old Dough Claim. (Modified slightly from original description in California Min. Bur. Rept. 17, p. 78, 1921.) This deposit was discovered in 1919 by J. E. Rees of Middletown, and one claim, the Old Dough, was located in 1920. It is in T. 12 N., R. 9 W., at an altitude of 2,700 feet. The nearest railroad station is Calistoga, 30 miles by good road. An ample supply of water is at hand. The deposit is said to be large and most of it is low grade. A few high-grade pockets are present. The deposit was undeveloped when visited.

No. 22. Ora Hans Prospect. (By E. F. Davis, June 13, 1918.) Ora Hans of Reiff owns a manganese prospect in the SW¼ sec. 20, T. 12 N., R. 5 W. It is exposed on the hillside close to the road from Knoxville to Lower Lake. The material consists of opaline iron manganese ore with less than 10 percent manganese. It contains silica in the form of porous, sometimes almost powdery cores. Greenish opal is found near the center of some of the larger blocks. The amount of manganiferous material on this property is small.

No. 23. Overlook Claim. (By E. F. Davis, July 23, 1918.) James D. O'Brien and R. C. Miller of Kelseyville, have a manganese claim 0.2 mile north of the second milepost west of Highland Springs on the Highland Springs-Pieta road. The prospect is in sec. 33, T. 13 N., R. 10 W. Pieta, the shipping point on the Northwestern Pacific Railroad, is 13 miles distant. The deposit is a siliceous iron ore with interbedded chert. Some parts of the main body are composed of opaline iron ore. A few lenses of massive chert cut by veinlets of manganese oxide are intercalated in the iron ore. Some of the chert lenses are pink and are porous; others are red and contain radiolaria. The radiolarian chert beds occur as groups of thin beds in the iron ore, separated from one another by thin red partings of the iron ore.

The iron mineral is easily scratched with a knife and crushes readily to a soft red powder. The deposit may be described as an iron oxide deposit showing manganese stains on weathered surfaces. It is of no commercial value, as it has too much silica and too little manganese. The iron deposit is entirely surrounded by outcrops of greenstone of the Franciscan group, some of which show a marked pillow structure. The relations between the ore and the igneous rock cannot be determined as none of the contacts are exposed.

No. 24. Phillips Mine. (By E. F. Davis and A. O. Woodford, August 3, 1918.) The Phillips manganese mine is on land owned by W. S. Phillips of Bechelor, Lake County. It was formerly leased to Lew Thorne and Son of San Francisco. It is in sec. 16, T. 15 N., R. 10 W., and is best reached from Ukiah, by the way of the Blue Lakes road from Ukiah to Laurel Dell. The mine lies 1.5 miles by trail from Laurel Dell, and is on the summit of a high peak which is S. 42° E. of the Laurel Dell Hotel. Ukiah is the nearest railroad point and is 21 miles from Laurel Dell over good road.

The northern and lower part of the mountain on which the mine is located is composed of sandstone of the Franciscan group, but near the summit considerable radiolarian chert is intercalated in the sandstone. This radiolarian chert strikes north and dips steeply west. Almost every body of chert yields manganese ore at some place within this area.

Except as noted below the ore is of one type. It is black oxide of manganese, usually rather soft and breaking easily with a hammer. On fresh fractures it shows a dull metallic luster. The specific gravity is high and the ore as examined in the field was judged to run about 45 to 50 percent of metallic manganese and 10 percent of silica. All the ore removed has come from shallow open cuts. The ore occurs in lenses in the red chert. These lenses lie parallel to the bedding. They are in some places associated with lenses of massive red or yellow chert but at other places the ore bodies are simply enclosed in red shale and chert without any associated thick chert beds.

Several ore bodies have been worked near the south end of the ridge on the summit of the mountain. They consist of small bodies of chert that show black stains of manganese oxide. No other ore was seen.

The No. 2 working lies at the south end of the summit of the ridge. Here an open cut across the top of the ridge has not penetrated the loose surface material. The red soil contains numerous small angular fragments of red chert together with blocks of yellow, manganese-stained chert. In addition many blocks of high-grade manganese ore, ranging in size up to a half ton are exposed.

The No. 1 working lies on the west side of the ridge 300 feet southwest of the No. 2 working, 60 feet vertically below the summit. The ore is in the same body of chert as the ore at working No. 2. The working here was an open cut. The sides have caved so that the mode of occurrence of the ore body and its relations are not determinable. An examination of the material extracted and piled on the dump indicates that the ore occurs in intimate association with a bed of red jasper cut by veinlets of manganese oxide. The ore is estimated to contain 20 percent manganese.

The No. 3 working lies on the summit of the ridge 200 feet north of the No. 2 working. Here a lenticular bed of high-grade manganese ore is enclosed within thin-bedded red radiolarian chert and red siliceous shale. The thickness of the ore body ranges between 10 inches and 3 feet. In one place it is seen to wedge upward.

The ore body and enclosing chert strike N. 20° W. and dip about 80° NE. On the hanging wall the ore is overlain by 4 to 7 feet of siliceous red shale. Overlying this red shale is coarse-grained sandstone. On the footwall side is red radiolarian chert with shale partings.

The No. 4 working starts at the top of the ridge 40 feet north of No. 3 working. Here an open cut 8 feet long and 4 feet deep has been dug, and ore has been removed. No important amount of ore is exposed here now, but from small pockets that are left, it seems certain that the ore lay above a bed of massive yellow and red jasper 2 to 3 feet thick and that both ore and massive jasper were essentially parallel to the enclosing thin-bedded chert and shale. The other No. 4 working consists of pits and trenches sunk along the ore zone. The ore zone is traceable for 100 feet down the west slope of the summit ridge to a point at an elevation of 25 feet below the crest of the ridge.

At its west end the massive red and yellow chert has disappeared from the ore zone and the body of high-grade ore 5 inches thick is enclosed in thin-bedded red radiolarian chert and shale. Midway between the two extremities is a thickness of 4 feet of high-grade ore enclosed in red radiolarian chert and shale.

The No. 5 working is 100 feet west of No. 3 on the west side of the summit ridge. It is 25 feet southwest of the most westerly working of the No. 4 group. At this place a trench-like open cut was run into the hillside in thin-bedded soft red shale and radiolarian chert, which strike N. 45° E. and are vertical. No ore is in sight but the form of the cut suggests that the ore body was a lens parallel to the bedding of the enclosing chert. The ore contains 42 percent manganese and 18 percent silica.

The No. 6 working is 200 feet north of No. 4 at an altitude of 50 feet below the summit of the ridge. Here a small open cut exposes broken blocks of chert in a red soil containing many blocks of high-grade manganese ore. In the extreme end of the cut massive yellow chert is exposed beneath a cover of soil. This chert contains a bed of high-grade manganese ore 3 inches thick. The soil above this massive chert is mantled by blocks of high-grade ore, indicating another source of ore farther up the hill. About 500 pounds of high-grade ore is piled here, having been removed from the open cut.

The No. 7 working is near the top of the ridge on its west slope about 300 feet north of No. 6. Here a massive lens of yellow, red, and red-brown jasper, having a maximum width of 8 feet and an exposed length of 20 feet, is seen in an open cut. It stands nearly vertical and trends northwest. The jasper contains pockets of high-grade ore but the amount of such ore is small. Ten feet northwest of this lens is another small pocket of high-grade ore.

The No. 8 working is a small open cut 200 feet west of No. 6, and is at an altitude of 75 feet below the top of the ridge. Here a quarter of a ton of high-grade ore was removed from a trench. The ore was all in loose blocks in the soil and none was in place.

This property was visited by Max D. Crittenden, Jr., in 1942. It had been idle since World War I but had been worked after it was visited by E. F. Davis in 1918, the total production being 400 or 500 tons.

No. 25. Rainbow Ledge Prospect. (By Max D. Crittenden, Jr., August 6, 1942.) The Rainbow Ledge prospect is on the property of O. B. Tyrer and a Mr. Erskine of Lakeport, in the SE¼NW¼ sec. 35, T. 15 N., R. 10 W. To reach this deposit from Lakeport, take the Scott Valley road, turn right at 5.9 miles across a small bridge, and at 6.7 miles turn right again over a small bridge. The property is 1.4 miles beyond this turn, on a ranch road.

An open cut, 20 by 12 by 8 feet, comprises the development on this property. The cut is located in a narrow lens of chert. The maximum thickness of the chert is 20 feet. The rocks have been sheared. A cross fault at the mouth of the cut appears to offset the ore. The ore bed shows a length of 15 feet, and ranges from 2 inches to a foot in width, but averages 10 inches. The ore is largely oxide, containing 45 to 55 percent manganese, and 10 to 22 percent silica. The ore body is reported to widen downward.

No. 26. Rattlesnake Deposit. (By E. F. Davis, June 8, 1918.) The Rattlesnake deposit is in the SW¼ sec. 29, T. 11 N., R. 5 W., near the Hermann claim (Lake 3). It is owned by O. E. Hermann. The ore consists of blocks of siliceous manganiferous iron ore in greenstone and serpentine. The blocks are found over an area of 60 by 40 feet. The largest blocks are 8 feet in diameter. The deposit has produced no ore.

No. 27. Rose Ranch Prospect. (By Max D. Crittenden, Jr., August 7, 1942.) The Rose Ranch prospect is owned by F. H. Rose of Upper Lake. It is in sec. 10, T. 15 N., R. 9 W., and is 6.2 miles by road northeast of Upper Lake. The deposit is located on a good-sized landslide in terrain typical of the Franciscan group. North of the house, in the scarp produced by the slide, lenses of thin-bedded red chert are interbedded or associated with sandstone, greenstone, and conglomerate of the Franciscan. Two open cuts have been made, one 350 feet northwest of the house, the other, 500 feet east of the house, but both expose only stained red chert with greenish shale interbeds. The general strike of the chert northwest of the house is N. 65° E., the dip, 35° to 40° N.

No ore is exposed except some landslide blocks southeast of the house. Here surface concentration produced thin layers of oxide ore that gave assays as high as 54 percent manganese. The primary material, however, probably did not assay over 10 percent manganese.

No. 28. Smythe Manganese Prospect. (Condensed from original description in California Min. Bur. Rept. 17, p. 79, 1921.) The Smythe deposit, owned by T. A. Smythe of Middletown, is on a branch of Dry Creek, 3 miles west of Middletown in T. 10 N., R. 7 W. A good road runs within 0.5 mile of the prospect. The deposit was discovered in 1918. It crops out high on the steep side of a hill at an altitude of 1,800 feet.

A lens of good ore crops out for 30 to 40 feet. It is 2.5 to 3 feet wide, strikes nearly north and dips into the hill at an angle of 45°. The country rock is sandstone and chert. Two or three tons had been taken out at the time of visit.

No. 29. Spring Hill Farm Deposit. (By E. F. Davis, June 7, 1918.) R. Peterson has discovered float of manganese on his ranch, the Spring Hill Farm, 5 miles west of Middletown on the road to the Helen mine. The deposit is believed to be in sec. 30, T. 11 N., R. 7 W. No ore body has been discovered though some prospecting has been done. In places along the road to the Helen mine, at a distance of 3 to 4 miles from Middletown, massive beds of chert are enclosed in thin-bedded chert showing stains of manganese and small amounts of ore. Nothing of commercial importance has yet been found in this vicinity.

No. 30. Summit Deposit. (By Max D. Crittenden, Jr., August 7, 1942.) The Summit deposit is located on the summit of the ridge west of Clear Lake, 0.8 mile south, by trail, of the highest point of the Lakeport-Hopland road. The probable location is sec. 2 or 11, T. 13 N., R. 11 W. It was located by A. H. Hoyt of Kelseyville. An open cut 30 feet long by 10 feet wide, and 5 to 6 feet deep exposes rather massive red chert, containing veinlets and interbeds of secondary oxide ore of good grade, separated by chert beds 1 inch to 12 inches thick. The chert strikes roughly east and dips 30° S. Small scale faulting and shearing is common. The total length exposed is 30 feet. The average grade of the ore body is estimated to be 30 percent manganese.

No. 31. Vann Ranch (Black Rock, Grizzly Canyon, Middle Creek) Prospect. (By Frank S. Simons and Max D. Crittenden Jr., July 23, 1942.) The Vann Ranch or Middle Creek prospect is in sec. 34, T. 17 N., R. 10 W., on the south slope of Horse Mountain between Grizzly Creek and the west fork of Middle Creek. It is 11.4 miles north-northwest of Upper Lake, and 37 miles from Ukiah, the nearest shipping point. The last 2 miles of the road are rather rough, especially at the fords of Middle Creek and Grizzly Creek. The road extends to within a quarter of a mile of the mine, at which point is a sulphur spring. The ore was sledded down the last quarter of a mile.

The ore deposit is in a rather narrow band of thin-bedded buff, shaly chert, bordered by brown, somewhat micaceous sandstone. The ore body is exposed intermittently for 125 feet along the strike. At the last exposure at the southeast end, an open cut exposes 6 feet of manganiferous chert, striking N. 80° W. and dipping 40° NE. into the hillside. The chert here contains a few thin partings of high-grade pyrolusite ore, but the greatest part of the ore has less than 20 percent manganese. Seventy feet northwest of this cut are several very promising outcrops of manganese ore, and 30 feet farther northwest an open cut and an adit 40 feet long expose 3 to 4 feet of siliceous manganese oxide ore, striking N. 35° W., and dipping 45° NE. A shallow winze at the end of the adit shows that the ore extends at least 15 feet below the surface. The ore at this depth shows no improvement over the ore near the surface, and there is no reason to think that additional depth will result in any higher-grade ore.

Twenty feet northwest of the adit, an open cut in brecciated buff chert exposes a small amount of oxide staining the chert. The chert here strikes N. 60° W. and dips 10° NE. (probably somewhat slumped). The ore wherever seen is a siliceous oxide ore, cut by many quartz veins. No ore was seen that contained more than 35 percent manganese, except a few thin pyrolusite partings, and the average grade is probably not over 25 percent manganese. The deposit could not be worked profitably at present market conditions.

No. 32. Von Glahn Prospects. (By Max D. Crittenden Jr., August 5, 1942.) The Von Glahn prospects are in the SW¼ sec. 5, T. 10 N., R. 7. W., on the property of Henry Von Glahn of Middletown. They are located 0.2 to 0.5 mile off the road to the Von Glahn house, and 3.5 miles from Middletown. In 1935 about 20 tons of ore was shipped from this property. It is reported to have assayed from 18 to 47 percent manganese, but to have been rather high in silica. Several prospects are present, but all are low in grade and small in size.

One prospect lies along the stream above the Von Glahn ranch, and is 20 feet above the creek. The workings consist of a 15-foot trench cut into the hill, and three small open pits. These expose sheared chert of the Franciscan group striking N. 20° W., and dipping 20° to 30° NE. The openings along shear planes are filled with secondary quartz and manganese oxides. The over-all grade of the ore is low.

The second prospect is located 250 to 300 feet up the slope from the first, and consists of an open cut 20 feet long. Here the chert strikes N. 60° W., dips 50° SW., and is heavily stained with manganese oxides. Near the center of the cut is a 2-foot bed of cherty ore, which lenses out in both directions, and does not appear to extend beyond the end of the cut.

A 6-inch zone lies along the hanging wall, which consists of cavernous oxide ore that contains about 35 percent manganese, but the quantity available is small. The greater part of the bed is manganiferous chert, which probably has less than 20 percent manganese.

A 20-foot adit was dug here in 1935 in an effort to follow a stringer of cinnabar in the face of the cut above the manganiferous chert bed, but the adit was begun too high to intersect the bed, and no manganese ore was found.

About 500 feet downstream from the first prospect, a small pit 20 feet above the creek exposes thin-bedded red chert interbedded with reddish manganiferous shale. These rocks strike N. 60° W., and dip steeply into a fault contact with sandstone of the Franciscan about 50 feet to the southwest. The ore contains less than 20 percent manganese.

On the east side of the creek, opposite the Von Glahn house, a small open cut exposes nearly flat-lying thin-bedded red chert which shows some manganese stains. The ore here contains less than 10 percent manganese.

Another prospect is located beneath two prominent Digger pines a quarter of a mile N. 62° W. from the Von Glahn house. Here, two open cuts expose highly sheared chert, and possibly some sandstone, with interbeds of manganiferous cherty ore. On the surface, the ore may contain from 20 to 30 percent manganese, but the ore that could be obtained by mining would not average over 10 to 20 percent manganese, and would be high in silica.

No. 33. Witter Springs Mine. (By E. F. Davis and A. O. Woodford, August 4, 1918.) The Witter Springs mine is owned by the Witter Medical Springs, Inc. Blake Brothers of San Francisco are mining the ore under a contract with the owners. The mine is near the center of the south line of sec. 32, T. 16 N., R. 10 W., and is 2,000 feet northwest of the Witter Springs Hotel, 1,000 feet from the road. Ore is hauled from the mine to the road in sleds and then hauled to Ukiah by auto truck at a cost of $6.00 a ton. The distance from the loading place to Ukiah is 26 miles but it is only 22.5 miles to the nearest railroad crossing.

The ore body is a thick bed enclosed in thin-bedded radiolarian chert and shale. The bedding planes of the chert are parallel to the walls of the ore body and where the walls curve due to variation in the thickness of the ore body, the chert bends to conform with this curvature. The chert along the walls of the ore body has been crushed and sheared. The ore body and the enclosing chert strike in general N. 30° W., and dip 55° E. The ore body is exposed over a length of 30 feet and is cut off at its south end by a fault. It ranges in thickness between 4 and 8 feet.

The internal structure of the ore body is rather complex as it consists of interlayered bands and lenses of different materials. In some places there are gradual transitions between the different materials, whereas in others the boundaries are abrupt. These boundaries are in general parallel to the bedding of the enclosing chert, so the ore bed shows a rude stratification.

The principal constituent of the ore body is massive jasper. This jasper is mostly cream to yellow in color. Some is black, some brown, and a small amount is red. A little white or gray jasper is also present. The jasper is cut by a complicated network of veinlets of manganese oxide. Generally the cream colored variety shows streaks and small lenses of other colors but though these streaks parallel the bedding, the rock does not part along them. The cream colored variety occurs in lens-like masses within the ore bed. The ore beds have a maximum thickness of 3 feet.

Associated with the jasper in the ore bed is a brown manganese ore of a variety which previous tests have shown to consist of a mixture of opal and manganese oxide in a state of oxidation lower than the ordinary black oxides. Along water channels and at exposed surfaces this material becomes changed into a siliceous black oxide of manganese with bright vitreous luster. The brown opaline ore occurs as irregular pockets or as bands in massive chert. The boundary between brown ore and enclosing jasper may be a transitional boundary. The brown ore also is found in thin lenticular beds separated from one another by soft shale partings. Some of these thin beds occur together as a lens-like body within the ore bed. The brown opaline material is generally cut by numerous veinlets of a pale-pink manganiferous carbonate. The ore bed also contains small lenses of thin-bedded red radiolarian chert with red shale partings. These chert beds occur in groups of lenticular beds separated by shale, each group of thin beds forming a lens in the ore bed.

Workings consist of an open cut 55 feet long and varying in width from 35 feet at its lower end to 5 feet at the upper end. The lower end of the cut is at an elevation of 40 feet below the upper end. A flat bench was cut into the hill just below the point where the ore is offset by the fault. Here a depth of 10 feet below the surface was attained in the farther end of the cut. The ore above this point is exposed in a cut, the bottom of which parallels the former surface and is nowhere more than 6 feet below it. The ore is extremely siliceous, not exceeding 20 percent manganese, and probably contains only 10 percent. Unless the ore can be concentrated, it has no value under present market conditions.

LOS ANGELES COUNTY

No. 1. Black Brothers Claim (Amargosa Group, Llewellyn Iron Property). (By Ivan F. Wilson, November 4, 1942.) The Black Brothers claim is on Portal Ridge, 4.3 miles by road west of Palmdale; it is probably in the NE¼ sec. 30, T. 6 N., R. 12 W. Palmdale is a rail point on the Southern Pacific Railroad. No claim notice was found on the property, and no one in the vicinity knew the name of the owners. However, the location corresponds to that given on the "Black Brothers" claim in the Bureau of Mines files. This is probably part of the Amargosa group of claims of the last war.

An old caved shaft and adit on the property presumably dated to World War I, but a bulldozer worked either in 1941 or 1942.

This property contains a manganiferous bed of quartzite, probably a metamorphosed chert, enclosed in quartz-mica schist, believed to be the Pelona schist of pre-Cambrian age. Portal Ridge contains a fairly large area of this schist, just north of the San Andreas fault. The manganiferous bed ranges in thickness from 1.5 feet in the northernmost cut to 9 feet in the shaft. The average thickness is 3 feet. The ore bed crops out for 165 feet. The maximum depth exposed is 10 feet, in the shaft. The bed strikes N. 20°-45° W., and dips 55° to 65° NE. It is offset by small cross faults. One of these faults in the bottom of the shaft strikes northwest and dips 35° SW., and has a reverse type of displacement of 4 feet.

The manganese ore consists of partly oxidized rhodonite and spessartite scattered among the quartz grains of the quartzite. It is cut by quartz veinlets ranging from a fraction of an inch to 3 inches in thickness. The spessartite occurs in yellow brown dodecahedral crystals. The rhodonite, which is more abundant, occurs in pink prismatic crystals as much as an inch in length. These minerals in places have been oxidized to hard psilomelane and soft black oxides; here and there patches of cellular silica are stained yellow with limonite. Very little good oxide ore has been found. Most of the black oxidized material still reveals crystal outlines of the original rhodonite or spessartite. The average grade of the bed is about 20 percent manganese. Probably none of the material contains over 35 percent.

No. 2. Gladwin and Peet Claim. (Modified from original description in California Min. Bur. Bull. 76, p. 38, 1918.) The Gladwin and Peet claim is in sec. 36, T. 6 N., R. 14 W., at an altitude of 4,900 feet, some 2,000 feet above the end of the wagon road in the canyon. It was first located many years ago and was relocated in September 1917 by G. L. Gladwin and H. G. Peet of Los Angeles. The manganese oxides are in small pockets along siliceous outcrops in the schist. The material is siliceous and in general low grade. Two small pockets, only a few feet deep, have been uncovered. Several tons of this low-grade oxide are on the dump. There are several other siliceous outcrops on the claim, but no other manganese outcrops were seen. The deposits are too small to be commercial.

No. 3. Purple Sage Group. (By Ivan F. Wilson, October 21, 1942.) The Purple Sage group of claims is in Texas Canyon, a branch of Bouquet Canyon, on the south flank of the Sierra Pelona in the NE$\frac{1}{4}$ sec. 7, and SW$\frac{1}{4}$ sec. 5, T. 5 N., R. 14 W. The claims were located May 30, 1942, by Clarence Cruzan of Los Angeles. They may be reached by driving 6.5 miles along the Forest Service road up Texas Canyon from its junction with Bouquet Canyon. From here one group of outcrops is located 0.5 mile by trail farther up Texas Canyon, and another is located about a mile by trail along a ridge just east of Texas Canyon. The area is covered by thick chaparral. The nearest rail point is 15 miles southwest, at Saugus on the Southern Pacific. The claims are idle, and little development has been done.

On the ridge just east of Texas Canyon is an outcrop of a manganiferous banded quartzite (probably a metamorphosed chert) enclosed in quartz-mica schist, which is believed to be the pre-Cambrian Pelona schist. The quartzite is 9 to 10 feet thick where it crops out on top of the ridge, and is said to extend for several hundred feet, although it was not traced by the writer. It strikes east and dips 60° S. A small shallow open cut has been opened on top of the ridge.

The quartzite contains pockets and lenses of partly oxidized pink rhodonite. In places the rhodonite is coated with thin films of black manganese oxides. Elsewhere pockets and lenses of manganese oxides a few inches to 2 feet thick are present. These oxides are mostly soft pyrolusite, but in part are psilomelane. Both the quartzite and manganese minerals are cut by quartz veins from a fraction of an inch to 3 inches thick. A few of the smaller pockets of manganese oxides may have as much as 40 percent manganese, but most of the material contains considerably less and the general run of the bed would probably not be over 10 percent manganese. It would require very careful sorting to obtain any ore of shipping grade.

In the bottom of Texas Canyon is an open cut 4 by 4 feet and 8 feet deep on a 2-foot bed of banded quartzite, likewise probably a metachert, cut by quartz veinlets and stained with manganese. A few small pockets of manganese oxides, mixed with considerable quartz are also present. Small garnet crystals occur. Some of the small pockets here may contain 30 percent manganese, but the general run of the bed is less than 10 percent, perhaps less than 5 percent. The quartzite strikes N. 70° E., and dips 70° NW. In the cut the bed is repeated by a sharp drag fold. The bed is said to crop out over a distance of several hundred feet.

No. 4. Red Feather (La Frentz) Claim. (By Ivan F. Wilson, October 30, 1942.) The Red Feather claim is on the crest of Portal Ridge west of Palmdale in sec. 24, T. 6 N., R. 13 W. It is reached by driving along the main road west of Palmdale for 5.5 miles, then turning north along a dirt road for 0.9 mile. The total distance from Palmdale, the nearest rail point, is 6.4 miles. The claim was located July 20, 1942, by H. E. La Frentz and M. M. La Frentz of Palmdale. It has been leased to G. T. Humphreys of Los Angeles.

This claim is presumably part of the Amargosa group of World War I, which consisted of nine claims. Another part of the Amargosa group is probably the Black Brothers claim (Los Angeles 1), farther east along Portal Ridge. Production of 168 tons has been reported from the Amargosa group of claims. Judging from the size of the workings, most of this amount probably came from the Red Feather claim. Several old workings are on the property.

The manganese ore at this property is found in a series of lenses of quartzite (probably metamorphosed chert) in a coarse-grained quartz-mica schist. This schist is believed to be the pre-Cambrian Pelona schist, which forms a large belt along Portal Ridge just north of the San Andreas fault. The quartzite and manganese ore are cut by quartz veins ranging from a fraction of an inch to 2 feet in thickness. The quartzite lenses are 1 foot to 6 feet thick. The various workings are scattered over a total length of 750 feet, but they are thought to be located upon a series of discontinuous lenses rather than on a continuous bed. The attitudes are variable, the strike ranging from N. 35° W. to N. 55° E., and the dip from 20° N. to 80° S. The average strike is N. 80° W., and the dip is 40° N. Several small cross faults cut the ore beds, one of which strikes N. 15° E., dips 55° E., and has a normal offset of 2.5 feet.

The manganese ore consists of partly to completely oxidized pink rhodonite. In places pockets 1 foot to 2 feet thick of fairly pure rhodonite occur; elsewhere the rhodonite is scattered among the quartz grains of the quartzite. Much of the rhodonite has been incompletely oxidized. However, in places considerable oxide ore has been developed. This oxide ore consists of hard psilomelane and soft black oxide, with patches a fraction of an inch to 2 inches in diameter of cellular silica, stained yellow brown by limonite. The best sample of oxide ore contained 31.07 percent manganese. Even in this sample the crystal outlines of the original rhodonite could be seen. Most of the ore contains between 10 and 20 percent manganese and much silica.

MADERA COUNTY

No. 1. Agnew Meadows Deposits (Mammoth Lakes). (By Parker D. Trask, September 20, 1941.) The Agnew Meadows deposits are at an altitude of 8,500 feet in the upper part of the canyon of the Middle Fork of the San Joaquin River in unsurveyed land near the center of T. 3 S., R. 26 E. They are situated at the position of the letter ''d'' in the word ''Meadows'' at Agnew Meadows in the Mount Lyell topographic sheet. They lie on the east wall of the canyon 200 feet above the bottom of the canyon, 0.8 mile by trail from the dirt road to Mammoth, 10 miles distant. Mammoth is 175 miles by paved highway from Mojave, the nearest rail point.

The deposits were located by Charles Summers of Agnew Meadows. Dr. Henry A. Stevens of Los Angeles is considering developing them. The ore bodies are hydrothermal deposits of vein origin. The ore occurs at the intersection of the vertical mineralized zones and schist. Three such zones in a distance of 2,000 feet were seen. The schist strikes N. 30° W. and dips 75° NE. It seems to be a partly recrystallized felsite and is highly impregnated with epidote. The mineralized zones strike N. 40° E. and are essentially vertical. They have a maximum width of 7 feet, but are exposed for only 50 feet. They are covered by talus at the base, but they seem to divided and feather or fade out at the upper end. They are characterized by garnet, some of which is typical skarn, and by pyrite, epidote, rhodonite, rhodochrosite, piedmontite (?), and a green mineral that weathers to a black manganese oxide (johannsenite?). The rhodonite seems to be localized mainly in a single stratigraphic zone 2 to 3 feet wide, and the rhodochrosite occurs in a similar zone 2 to 3 feet above the rhodonite.

The total width of the manganese deposits is not over 6 feet and the length along the strike in each of the three zones is less than 10 feet. In no locality is the rock completely replaced by manganese minerals. The grade is less than 30 percent manganese. At the northernmost exposure fine-grained hematite was seen in a thin bed just below the manganese zone.

No. 2. Hazelton and Kennedy Claim. (By N. L. Taliaferro and Theo Crook, June 15, 1918.) The Hazelton and Kennedy claim was located by J. W. Hazelton and W. C. Kennedy of Madera County. It is in sec. 28, T. 9 S., R. 22 E., 12 miles east of O'Neals Post Office, and 35 miles northeast of Madera. It is 3 miles by trail from the nearest road. Development work consists of a small pit 7 feet deep. This pit is on the west side of the canyon of the San Joaquin River 800 feet above the river and at an altitude of 1,800 feet. Lenses of rhodonite-spessartite-quartz rock occur in a quartz schist. These lenses are parallel to the schistosity. The belt of schist in which the rhodonite rock is found is not over 60 feet wide, being a schist inclusion in a body of granite. The manganese rock and the enclosing schist have been thoroughly metamorphosed by dynamic and contact action. The schist was originally a rock composed almost wholly of silica, perhaps chert and siliceous shale.

No. 3. Krohn Prospect. (By N. L. Taliaferro and Theo Crook, June 15, 1918.) A manganese claim was located in sec. 22, T. 7 S., R. 21 E., by H. A. Krohn of Coarsegold. It is 4 miles north-northeast of Coarsegold and 18 miles northeast of Raymond. Development consists of an open cut 12 feet long and 8 feet deep. A few small lenses of partly oxidized rhodonite rock occur in quartz-mica schist, which may be referred to the Calaveras formation. No ore of commercial value has been found and there is no likelihood of any being encountered. Only a few pounds of rhodonite rock is in sight.

No. 4. Scott Prospect. (From files of U. S. Geological Survey, 1942.) A letter in the files of the U. S. Geological Survey from Wm. A. Vinson of Madera mentions a manganese deposit owned by S. A. Scott of Coarsegold. The location of the deposit is not given.

No. 5. Stewart and Nuss (Teaford) Prospect. (By Ivan F. Wilson, September 25, 1942.) The Stewart and Nuss prospect is located on the crest of a high ridge known as Thornberry Mountain in sec. 1 or 2, T. 8 S., R. 21 E. It is 9.4 miles by road east of Coarsegold; 4.3 miles northeast along Highway 41, then 5.1 miles southeast along dirt roads. The nearest shipping point is 23 miles to the southwest at Raymond on the Southern Pacific Railroad. The prospect is owned by George and Otis Teaford of North Fork. It has been leased to Stewart & Nuss, Inc., of Fresno. No ore has been shipped; and as far as known, the property is now idle.

Development consists of cuts on both sides of the ridge. On the north side of the ridge is a cut 87 feet long and 20 feet deep, which extends southward into the hill. This is called the "north cut." A shaft is sunk at the southeast end, 7 by 6 feet and 35 feet deep below the level of the cut; and 200 feet to the southeast on the south slope of the hill a large cut has been made with a bulldozer. This cut, which is 200 feet long, 50 feet wide, and 30 feet deep, is called the "south cut."

The cuts reveal a series of lenses of manganiferous, massive metachert which has been recrystallized to a fine-grained and to a coarse-grained gray and white quartzite. Quartz veins cut the chert. The massive metachert is interbedded with quartz-mica schist which may represent original siliceous shale or impure thin-bedded chert. The beds are 0.5 inch to 1.5 inches thick averaging 1 inch. Both the massive metachert and the enclosing schist are cut by flat dikes of granite. In the north cut one dike 0.5 to 1 foot thick extends nearly horizontally around the east and south walls of the cut, 5 to 9 feet above the floor. From 2 to 6 feet below this cut is another mass of granite which extends 3 feet above the floor of the cut and continues down below the floor. The rock is a highly decomposed white, coarse-grained biotite granite, close to an alaskite in nature. It contains a little biotite and orthoclase, altered to kaolin. A similar horizontal granitic dike 2 to 3 feet thick occurs in the south cut. Three pegmatite dikes 4 to 6 inches thick were also noted.

The north cut reveals three beds of manganiferous, massive metachert which from northeast to southwest are 1.5, 4, and 3.5 feet thick respectively. The south cut reveals six beds which from northeast to southwest are 5, 5, 2, 3, 5, and 2 feet thick respectively. As the ridge between the north and south cuts has few outcrops, it is impossible to determine which, if any, of these beds extend between the two cuts, but the intervening area contains float and manganiferous metachert.

The schist and metachert strike N. 20°-40° W., and dip 35° to 50° SW. This area is mapped on the State geologic map as granite. The schist exposed at the prospect may be a roof pendant in the granite. The rocks have been subjected to contact metamorphism in addition to dynamic metamorphism.

The beds of massive metachert contain brown manganese garnet (spessartite) and pink rhodonite scattered among quartz grains. The spessartite is more abundant than the rhodonite and occurs in fairly large dodecahedral crystals. Locally it is found in nests, but more commonly the grains are disseminated through the quartz of the metachert. The garnet and rhodonite tend to be stained and coated with manganese oxide, and in places there are crusts and small pockets of the oxide. However, hardly any masses of oxide of a minable size were seen. All the oxide material appears to be low grade, and most would probably not exceed 10 percent manganese. The manganiferous ore in this deposit is low grade. Very little oxidized material is present, and even the primary spessartite and rhodonite are low grade, being mixed with much quartz. No tonnage of shipping ore was seen. Some 10,000 tons of spessartite and rhodonite running lass than 10 percent manganese may be present.

No. 6. Thornberry Prospect. (By Spangler Ricker, 1942.) The Thornberry prospect is in T. 7 or 8 S., R. 21 or 22 E., about 5 miles from the railroad. The owner is S. A. Vaneman. The ore consists of films of manganese oxide in a quartzite bed 20 feet thick. Assays run from 2.1 to 6.3 percent manganese, and 1.4 to 2.2 percent iron oxide.

MARIN COUNTY

No. 1. Fort Baker Deposit. (Modified slightly from original description in Lawson, A. C., San Francisco folio: U. S. Geol. Survey, Geol. Atlas 193, p. 23, 1914.) A deposit of manganese is exposed in a road cut near Fort Baker in T. 1 S., R. 6 W. It consists of a stratified deposit of hard, clean psilomelane about 18 inches thick, grading off in its upper part into a lean ore consisting of chert and shale highly charged with the black manganese mineral. There is no definite boundary between this lean ore and the normal radiolarian chert, for the proportion of psilomelane decreases till it ceases to color the rock. The thickness of the chert impregnated by ore above the layer of psilomelane is about 12 feet. This body of ore lies within a few feet of an intrusive contact of ellipsoidal basalt with the chert, the contact plane being parallel to the bedding, and may be traced for 90 feet on the outcrop of the formation, which dips about 40° SW. In several samples taken by D. C. Billick, the psilomelane contains gold not exceeding 40 cents to the ton.

No. 2. Knutte Deposit. (From files of U. S. Geological Survey, 1942.) The Knutte deposit is in the NW¼ sec. 19, T. 3 N., R. 6 W., east of Novato. It is under lease to L. R. Knutte and is typical of deposits in chert of the Franciscan group.

No. 3. Mailliard Ranch Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 38, 1918.) On the Mailliard ranch, 8 miles northwest of San Rafael and 0.5 mile south of Woodacre Lodge, probably in sec. 13, T. 2 N., R. 8 W., stains and irregular patches of manganese oxide occur in red jasper which apparently has been caught up as blocks in serpentine. The material is high in silica and has not been developed. The property is in lot 9, block 33, of a tract owned by the Lagunitas Development Company of San Francisco.

No. 4. The Mazza Prospect. (By E. F. Davis and F. S. Hudson, March 3, 1918.) The Mazza prospect is located on the property of R. Mazza, 6.5 miles south of Petaluma. It would lie in the SW¼ sec. 28, T. 4 N., R. 7 W., if the sections survey was made. Development consists of a pit whose horizontal dimensions are 20 by 20 feet. The ore body lies parallel to the bedding of the enclosing chert and strikes N. 25° E., and dips 60° SE. The hanging wall consists of soft brownish iron-stained chert; the footwall is covered by alluvium. The ore zone is at least 15 feet thick.

The ore minerals consist of a mixture of manganese carbonate and silica. Both gray and pink carbonate are present. Silica seemingly increases toward the footwall of the ore body. The material in the lowest exposed part of the ore zone consists of scattered spherules of carbonate in a gray chalcedonic matrix. The better ore occurs in bunches up to 2 feet in diameter, enclosed in more siliceous material. Numerous quartz veins traverse the ore body. Cubes and irregular masses of pyrite are found locally in the ore. A few specks of cinnabar were seen. Along the hanging wall, a small amount of oxidation has occurred, resulting in black oxide that contains considerable amounts of silica both disseminated within the oxide and in the form of residual cores. Oxidation has also taken place along joints within the ore body. As far as can be judged from the exposed material, no ore here could be profitably extracted.

No. 5. Petaluma-Point Reyes Prospect. (By E. F. Davis and F. S. Hudson, March 3, 1918.) On the north side of the road from Petaluma to Point Reyes, 1 mile south of the Union School in the north center of sec. 30, T. 4 N., R. 7 W., a bed of massive manganese ore crops out. It may be traced on the surface for 40 feet and appears to be at least 3 feet thick. The material in the outcrop consists of black manganese oxide with iron stained spherules of silica. The silica content probably runs from 20 to 35 percent.

No. 6. Sausalito Point. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 39, 1918.) About 1 mile west of Sausalito Point in T. 1 S., R. 6 W., manganese oxides are associated with massive chert. The oxide is mostly of low grade, but one lens of good ore has a thickness of 15 inches and can be traced for 6 feet. No attempt has been made to develop the prospect.

MARIPOSA COUNTY

No. 1. Caldwell (Daly) Mine. (By Ivan F. Wilson, September 21, 1942.) The Caldwell mine, known as the Daly mine during World War I, is 8.5 miles southwest of Coulterville in the NE¼ sec. 14, T. 3 N., R. 15 E. It is reached by proceeding along the road west of Coulterville 6.9 miles to the Granite Springs School, turning south for 1.5 miles, then west through a gate into the Caldwell Ranch. From here a road branches to the right (northwest) for an additional 0.2 mile to the northern workings, and another branches to the left for an additional 0.4 mile to the southern workings. The workings are situated in an area of fairly gentle topography partly covered with manzanita brush. The northern workings extend over two low ridges, across a ravine; the southern workings are near the crest of another ridge to the south. The nearest shipping point is 8 miles by road to the south, at Barrett Station on the Yosemite Valley Railroad.

The property is owned by Claude C. Caldwell, Marguerite Caldwell, and John J. Caldwell. It was formerly leased to Gertrude Hickman and Walter McVicar, but is now leased to Walter Hixson of Raymond, Madera County. The property is idle at present.

The principal development consists of a shaft inclined 45° southeast, and 57 feet long. From the bottom of this shaft a drift extends 26 feet southwest. A second shaft, 10 feet deep, lies 500 feet south of the main shaft, and a third shaft, 15 feet deep, is 300 feet south of the second shaft. In addition, 30 open cuts of varying sizes have been opened along the ore zone over a distance of more than 1,000 feet.

The manganese ore at this property is a bed or series of lenses enclosed in chert. The chert includes thick-bedded to massive red chert, thin-bedded buff to gray chert, and massive to thick-bedded white chert. The chert is enclosed in gray to greenish metatuff and metavolcanics. These beds belong to the Amador Group, and the chert has been named the Hunter Valley chert by Taliaferro.

The northern group of workings has followed an ore bed over a total length of 750 feet in a northerly direction—as far north as the inclined shaft. The bed may not be continuous over this length, as it probably is lenticular. The manganese bed and enclosing chert strike on the average N. 5° E. over this distance, but the beds curve from place to place and the strike varies locally from N. 30° W. to N. 45° E. The dip in general is to the east, ranging from 50° to 80°, but in two or three places the dip is 80° to 85° W.

Starting 85 feet north of the inclined shaft, a series of cuts follows the chert an additional distance of 320 feet to the northwest. A little manganese ore, mostly low grade, was encountered in these cuts. The strike of the beds in these cuts ranges from N. 25°-50° W., and the dip, 75° E.

The southern group of workings is a quarter of a mile south of the northern group, and exposes a manganese ore bed in what is apparently the same belt of chert. These workings cover a length of 170 feet. The chert here is thin-bedded with shale partings and is red, white, and pale green in color. The chert occurs in beds an inch or so thick, separated by shale partings an eighth to a fourth of an inch thick. It contains what appears to be radiolarian remains. There are also bold outcrops of massive red chert. The beds in the southern workings strike north to N. 45° W., and dip 55° to 75° E.

Ore is now exposed mainly in the third shaft at the south end of the northern workings, and in the inclined shaft. It is also exposed in a few of the cuts, but most of these cuts, which date back to World War I, have caved. The third shaft exposes 2 feet of high-grade oxide ore (mostly psilomelane). This bed of oxide seems to split into two parts each about 1 foot thick at the southwest end, separated by a metavolcanic rock resembling a metabreccia.

The inclined shaft reveals 2.5 to 5 feet of ore on the southwest side, which wedges out toward the northeast. This ore is partly oxide ore (mostly psilomelane) but in large part is unoxidized ore, which is a brown to gray or rose colored cherty manganiferous calcium carbonate (manganocalcite). Analyses made in 1918 indicated that this material ran 20 to 23 percent manganese, 30 to 40 percent silica, and was high in lime, indicating the probable presence of manganocalcite. An exposure about half way down the shaft reveals 2.5 feet of hard, brittle carbonate and psilomelane ore surrounded on each side by 1 foot of soft, black oxide ore. Some psilomelane ore is exposed in the drift at the bottom of the shaft, but most of the material here is the primary carbonate ore, which is 3 to 4 feet thick. The dump at the inclined shaft contains 10 or 15 tons of carbonate ore which has been discarded. Near the top of the shaft the ore bed is cut by a longitudinal fault, forming a gouge zone, which nearly parallels the ore bed but cuts across it at a slight angle. Some black oxide ore half a foot to 2 feet thick is exposed in cuts south of the inclined shaft. Gray carbonate ore is piled on the dump beside the inclined shaft. About 6 inches of ore is exposed in cuts north of the shaft.

In the southern group of workings, up to 2 feet of soft, shaly, black oxide ore is exposed at the southern end of the ore zone. An old dump here contains an estimated 13 tons of rather soft, porous ore, pyrolusite, and botryoidal psilomelane, with red iron oxide stains, and white patches of silica.

The total past production of this mine is about 250 tons. Part of this was produced during World War I and part was shipped 5 years ago. The ore averaged 45 percent manganese. The 1918 report lists the production at that time as about 100 tons, averaging 45 percent manganese, 6 percent iron, and 13 percent silica. On the dumps at present are about 15 tons of oxide ore, probably running over 35 percent manganese, and 15 tons of carbonate ore, running 20 percent manganese. A shipment of 9 tons in 1942 ran 49.3 percent manganese, 4.1 percent aluminum, 2.1 percent iron, 0.038 percent phosphorus, 11.3 percent silica, and no zinc.

This is one of the largest manganese mines seen in the Sierra Nevada south of Plumas County, from the standpoint of extent of workings, production, and reserves. If the carbonate ore could be utilized, the possibilities of the mine would be greatly increased.

No. 2. Donnelly (Carrier) Prospect. (By Ivan F. Wilson, September 23, 1942.) The Donnelly prospect, presumably at the same location as the Carrier prospect of World War I, consists of four claims owned by J. C. Donnelly, probably in sec. 17, T. 4 S., R. 19 E. The prospect is on a steep slope on the west bank of Sweetwater Creek, crossing the road to the Donnelly ranch 0.1 mile south of the ranch house. It is a mile by road north of the Sweetwater Gold mine, and 15 miles northeast of Mariposa.

The manganese ore here consists of small pockets, lenses, and stringers of manganese oxides in a massive metachert (fine-grained gray quartzite) cut by gently dipping quartz veins. The metachert is enclosed in gray to yellow sericite schist. The rocks belong to the Calaveras formation. The strike is N. 15° W., and the dip is 70° W. The belt of metachert is 23 feet wide in a gulch below the road, and it crops out at intervals over a distance of 300 feet up the slope above the road, where it is 20 feet wide. The only development is an open cut 300 feet above the road.

The pockets and stringers of manganese oxide are mostly too small to be mineable, in general not exceeding 6 inches in thickness. In places are alternating ribs of manganese oxides and silica. The manganese oxide includes psilomelane and pyrolusite. Assays were quoted of 30 percent manganese. No unoxidized ore was seen, but in the similar Strickland prospect (Mariposa 6) to the north, the primary mineral is rhodonite.

No. 3. Gale Prospect. (By Ivan F. Wilson, September 22, 1942.) The Gale prospect is in sec. 1, T. 3 S., R. 15 E., 7.3 miles along the road west of Coulterville. It is on property owned by W. T. Gale of Coulterville. The deposit is on a low knoll 200 yards southeast of the Gale ranch house, on the south side of the road. No development for manganese has been done on the property. One old shaft 6 by 6 feet, and 20 feet deep, is said to have been sunk in the eighties. This shaft reveals chert, but no manganese ore. Massive to thick-bedded white, yellow, and pale-red chert is found in the vicinity. These chert beds contain manganese stains, and in one or two places they have stringers of psilomelane up to half an inch thick. The chert strikes north, and dips 70° E. It is probably part of Taliaferro's Hunter Valley chert of the Amador Group, which appears also at the Caldwell mine and at Jasper Point (Kelm prospect, Mariposa 4) on the Merced River. No manganese ore was seen at this prospect.

No. 4. Kelm Prospect. (By Ivan F. Wilson, September 24, 1942.) The Kelm prospect is located at Jasper Point, a station on the Yosemite Valley Railroad, on the south bank of the Merced River (near the Exchequer Reservoir). It is in sec. 19, T. 3 S., R. 16 E. The prospect is on a steep northwest slope on the east side of a ravine 100 yards south of the railroad tracks. There is no road to the prospect, and the labor and equipment have been transported by train. The property was idle when visited. The prospect is owned by Herbert J. Kelm of Raymond and by the Allebrand Minerals Company of San Fernando. Mr. Kelm operated a jasper quarry on the property for a number of years. He did some development work on the manganese prospect in 1941, but no ore has been shipped.

In the jasper quarry east of the manganese deposit is chert several hundred feet thick, intercalated with green metatuff and metavolcanic rocks. There are many alternating layers of thick-bedded purplish-red and green chert. The chert has a dip of 35° to 40° E., and a strike of N. 0°-20° W. The manganese prospect is near the base of the chert section. The chert is underlain by a greenstone or pillow basalt, showing a well developed ellipsoidal pillow structure. This chert has been named by Taliaferro the Hunter Valley chert member of the Amador Group.

The manganese ore consists of a bed or series of lenses enclosed in thick-bedded red chert. It is exposed mainly in an open cut 10 by 8 feet, and 15 feet deep at the face, and by shallower cuts farther up the slope. This cut exposes a manganiferous bed up to 6 feet thick. The high-grade ore occurs as zones or lenses averaging 1.5 feet thick. These ore zones have sharp boundaries and could easily be separated from the enclosing manganiferous chert. One such lens is exposed in the bottom of the cut; up the slope are at least two other such zones of high-grade ore. The bed is cut by small transverse faults, and the base of the ore bed is sheared. One prominent fault strikes N. 80° E., and dips 70° S. The chert here has a strike of N. 25° W., and a dip of 45° NE. The manganiferous body is exposed on the surface for a distance of 35 feet. The surface slope at this point has an inclination of about 35°.

Ore crops out in two or three places 50 to 100 feet up the hill from the ore bed just mentioned. These outcrops are at about the same horizon, but there is no evidence of the continuity of the ore between. Between the main cut and these outcrops a tunnel has been cut into the hill for jasper. This tunnel is 30 feet long, bordered by a cut 30 feet long, trending S. 20° E. into the hill. It reveals thick-bedded red chert, striking N. 35° W., and dipping 50° NE. This place is at a horizon a few feet above and northeast of the manganese bed. The chert underlying the ore bed is cut by quartz veins 3 to 4 inches thick. Some of these contain considerable quantities of pyrite in cubic crystals, either scattered through the vein or in nests.

The ore consists of manganese oxide, in part botryoidal, hard, blue black psilomelane; and in part soft, black, sooty pyrolusite. No unoxidized manganese minerals were seen. The high-grade lenses of ore probably run 45 to 50 percent manganese. Assays were quoted by Mr. Kelm at 46 to 50 percent manganese, with the other constituents in one assay determined as 1.6 percent iron, 5.8 percent silica, 1.2 percent alumina, and 1 percent zinc.

No. 5. Robie Prospect. (By Ivan F. Wilson, September 20, 1942.) The Robie prospect is 8 miles west of Coulterville in sec. 2, T. 3 S., R. 15 E. It is on the south side of the road running west from Coulterville, 0.8 mile west of Granite Springs School, which is 6.9 miles west of Coulterville. It is on property owned by John L. Robie, Lazy J Ranch, Coulterville. The prospect is on a low ridge southeast of the Robie ranch house.

One small pit 4 by 4 feet by 1 foot deep is located on the property. This bit reveals massive to thick-bedded white chert more or less penetrated by bands and stringers of psilomelane. Most of the material exposed appears to contain about 50 percent silica in the form of white chert, and the manganese content is perhaps 20 to 30 percent. An assay of 30 percent manganese was quoted. This ore is probably about the best that could be obtained from the material exposed here. The bands of psilomelane are too small to be separated from the chert by hand sorting.

The prospect is a part of a large belt of chert, mostly white, but some of it is red. It strikes N. 10° W., and dips nearly vertically. This belt probably extends south through the Caldwell mine (Mariposa 1) and the Jasper Point prospect (Mariposa 4) on the Merced River. It is part of the Amador Group of Taliaferro, and was named by him the Hunter Valley chert.

No. 6. Strickland (Mebold and Camin) Prospect. (By Ivan F. Wilson, September 23, 1942.) The Strickland prospect, which is probably the same as the Mebold and Camin claim of World War I, is in sec. 8, T. 4 S., R. 19 E. It is on the west bank of Sweetwater Creek, 3.2 miles by road north of the Donnelly prospect (Mariposa 2). It is about 16 miles by road, northeast of Mariposa. The prospect is said to be on patented land owned by Mrs. Anna Strickland of Hollywood. A claim notice, located by Hugh Andrew Mulkern of Santa Monica, dated April 1, 1942, was seen on the property.

Development consists mainly of an irregular shaped cut trending S. 15° E. This cut is 65 feet long, 3 to 15 feet wide, and 3 to 6 feet deep. It reveals a bed of manganiferous massive metachert, recrystallized to fine-grained gray quartzite, 13 feet in maximum thickness, and averaging 5 feet. The metachert is cut by quartz veins, and is enclosed in sericite schist. The general strike is N. 60° W., and the dip 75° SW. The rocks belong to the Calaveras formation. In one place the metachert is cut by a porphyry dike 1.5 feet thick. Some smaller shallow cuts farther up the slope, south of the main cut, reveal mostly sericite schist; evidently the metachert wedges out in this direction.

Manganese oxides are more or less disseminated through the metachert, but the highest-grade ore occurs in pockets and lenses. Some of these lenses reveal high-grade ore containing 45 percent manganese. This high-grade ore is mostly nodular, botryoidal psilomelane and to a minor extent pyrolusite. Ore of shipping grade which could be separated by hand sorting probably averages 1 foot or 2 feet in thickness over the length of the main cut. The rest of the metachert in this cut contains between 10 and 35 percent manganese. Some patches of pink rhodonite were seen in specimens on the dump, and this is probably the main mineral from which the manganese oxides were derived in this deposit.

No. 7. Surprise (M-Q) Claim. (By N. L. Taliaferro, June 22, 1918.) The Surprise claim was located by E. B. Pine of Coulterville. It is in the E½ sec. 23, T. 3 S., R. 17 E., 8 miles by road and trail, northeast of Bagby, on the Yosemite Valley Railroad. There are 2 miles of trail and 6 miles of steep mountain road to the railroad. This was formerly known as the M-Q claim. Development consists of a shallow cut on an outcrop of manganese ore on Indian Creek, about 0.2 mile from its junction with the North Fork of the Merced River. Ore is exposed only in the bottom of the gulch.

The general country rock is dark blue-gray to black phyllite, containing small lenses and layers of quartz schist, or quartzite. The phyllite strikes N. 60-70° W., and is either vertical or has a high dip to the east. These rocks may be referred to as the Calaveras formation. Their exact position in this group is not known but they are near the western edge of what may be the main eastern belt of the Calaveras. Although rocks of the Calaveras have been mapped to the west of this great belt, it is doubtful if any true Calaveras occurs outside of this belt.

The ore is associated with one of these beds or lenses of quartz schist. It apparently occurs as lenses within the quartz rock and is parallel to the schistosity of the enclosing rocks. There is no evidence of veining or that the manganese has been secondarily introduced. The unoxidized ore varies considerably in character. The prevailing type is a pink to gray or fawn-colored manganese carbonate-rhodonite with scattered grains of spessartite. The ratio between the manganese carbonate and the rhodonite varies considerably. In places the ore consists largely of carbonate with scattered grains and crystals of rhodonite; in other places it consists largely of rhodonite. In places small yellow to red-brown garnet is common. The garnet crystals are usually coated with a film of manganese oxide and are probably spessartite. The primary ore seems to have been a siliceous manganese carbonate. Dynamic metamorphism has caused the development of rhodonite and spessartite through the carbonate rock. A partial analysis of a representative sample of primary ore made at the Berkeley Station of the U. S. Bureau of Mines indicated the rock was composed of equal parts of rhodonite and rhodochrosite. The oxidation has been superficial and has extended inward from the surface and along cracks only to a depth of 6 or 8 inches. An analysis of carefully selected oxide ore by a commercial analyst reportedly gave the following results: Manganese, 41.30 percent; iron, 2.80 percent; silica, 8.10 percent; sulphur, .04 percent; and phosphorus pentoxide, .13 percent.

MENDOCINO COUNTY

No. 1. Ash Hollow Prospect. (By N. L. Taliaferro, October 31, 1917.) The Ash Hollow prospect is on deeded land belonging to W. H. Fitzhugh, and is near the head of Ash Creek. It is 2 miles northeast of Hulls Valley and 14 miles by road north of Covelo in the southwest part of T. 24 N., R. 12 W. The manganese occurs as veinlets and mirrors in a block of thin-bedded chert and shale included in serpentine and greenstone. The serpentine appears to be later than the greenstone. The chert block is 15 feet long and 7 feet thick. The thin-bedded chert and shale are intensely filmed and mirrored with manganese on every surface and minute crack. This coating of manganese is misleading as it gives the prospector an erroneous idea as to the amount of manganese present.

The thicker chert layers are cut by numerous small veins of black manganese oxide. Under the microscope the chert is reddish brown (red in reflected light) due to red iron oxide. Partial crystallization to fibrous chalcedony has begun. Numerous radiolarian remains may be seen, these having been almost wholly crystallized to chalcedony and quartz; and only slight traces of their original structure is left. The chert is veined with calcite, quartz, and black manganese oxide (psilomelane?), all of which are apparently contemporaneous. In the slide examined no trace of any original manganese mineral could be found. All the manganese is apparently secondary.

No. 2. Bevins-Busch (Lee, Potter Valley) Claim. (By E. F. Davis and F. S. Hudson, July 26, 1917.) The Bevins-Busch claims are owned by Bevins and Busch of Potter Valley, and are at present under lease to F. W. Keeney. This group of claims is in secs. 3 and 10, T. 17 N., R. 12 W., 5 miles northwest of Potter Valley Post Office. They lie on the east side of the divide between Redwood and Potter Valleys. The property has produced 200 tons, mostly after 1917.

Manganese stains are widely distributed, but development has been confined to four places. On the northwest end of the property a body of massive psilomelane 1.5 to 2 feet wide is exposed in a short tunnel. The ore body strikes N. 70° W., and dips 60° NE. The footwall of the ore body is composed of well-bedded red radiolarian chert the bedding being parallel to the ore body. The hanging wall is of massive chert that has been somewhat brecciated. The second working place is in the central part of the property. Here an ore body 2.5 feet thick has been exposed. The ore consists of masses of hard psilomelane mixed with soft ore, probably pyrolusite. As numerous faults cut the ore body, its relation to the wall rocks is not clear. No work was being done on the No. 3 working at the time of our visit.

The fourth working is at the south end of the property. Here a thin seam of poor ore has been exposed in an open cut. The ore body strikes about east and dips 60° S. It ranges in thickness from 1 foot to a mere film. It lies within, and parallel to, well-bedded red chert and shale. On the hanging-wall side the ore is separated from the bedded chert by a 6-foot thickness of massive red and yellow chert, cut by numerous veins of quartz and chalcedony, and by seams of manganese oxide.

No. 3. Big Bend Claims. (By N. L. Taliaferro, October 29, 1917.) The Big Bend claims, two in number, are on the county road 2.5 miles east-northeast of the Covelo Ranger Station and are near the bend in the Middle Fork of the Eel River where the course of the river changes from southwest to west. These two claims are in the N½SW¼ sec. 28, T. 23 N., R. 11 W. The locators are C. V. Brereton, M. G. Morrison, J. D. Morrison, and W. E. Shields of Covelo.

No development work has been done and no ore is exposed in place. About 0.1 mile south of the county road and on the west side of a low ridge, blocks and fragments of fairly good oxide ore are found for a distance of 250 feet in a northeast direction. The largest blocks are 1 foot in diameter. Red chert is the predominant float rock here.

The ore on the surface is porous and consists of psilomelane, pyrolusite, and dark brown to black earthy mixture of oxides, which for lack of a better name will be called wad. The ore contains a variable amount of silica in the form of secondary quartz veinlets and as residual cores of leached chert. Many of the residual cores and patches of chert are pitted with many small spherical cavities up to 0.4 millimeter in diameter. Since the manganese oxides are seen to be derived from this spherulitic chert, it is safe to assume that the small cavities were once occupied by spherules of manganese carbonate. Another type of float is seen in which the original manganese ore appears to have occurred in lenses 1 millimeter to 3 millimeters thick, separated by equally thin layers of chert containing many small spherical cavities. These small lenses, now more or less completely replaced by black manganese oxide, may have originally been lenses of manganese carbonate. On the whole the ore seems to have been derived from a chert containing more or less manganese in the form of spherules of manganese carbonate. Therefore, it is probable that commercial ore will be found only in the oxidized zone.

No. 4. Brereton Mine (Michaels, Roman, and Weeks; New Year; Old Country Deposits). (By Ivan F. Wilson, July 7, 1942.) The Brereton mine is east of Covelo in sec. 31, T. 23 N., R. 11 W., on the steep north side of the ridge sloping down toward the Middle Fork of the Eel River to the west. It is at an altitude of 2,000 to 2,100 feet, and is 100 to 200 feet above a stream to the north. It is now reached from Covelo by driving 12 miles east to the Eel River Ranger Station, then going back toward the west along the south side of the Middle Fork of the Eel River for 3 miles to the site of the old Covelo Ranger Station. Near here the bridge has washed out. Across the river from here, a road runs up the mountain to the east for about a mile to Capt. Smith's Ranch (Rancho de Mañana). The mine is a quarter of a mile by trail east of Capt. Smith's Ranch.

The total distance by road from the nearest shipping point at Los Rios on the Northwestern Pacific is 32 miles; however, if the river could be crossed at the old Covelo Ranger Station, the distance would be reduced to 26 miles. The mine is on property owned by Mrs. J. Q. White of Ukiah. It has not been worked since World War I, when it was operated by C. W. Hymer and L. E. Rufener of Covelo. Former names for the mine are: New Year, Michaels, Roman and Weeks, and Old Country. The total production is about 150 tons, all during World War I.

The ore at the Brereton mine is in faulted bodies of chert striking northeast and dipping northwest. The chert is underlain on the southeast by sandstone. Chert occurs on the ridge southwest of the mine, but sandstone is the chief rock there, and up the ridge to the southeast. A bed of sandstone at the top of the ridge strikes N. 35° E., and dips vertically. Down the ridge to the northwest the rock is chiefly diabase and greenstone. Sandstone is found below the greenstone.

Most of the ore was obtained from open cuts and stopes and at least two tunnels in the eastern part of the property. All these workings are caved and the ore is not now exposed, so the relations cannot be determined. However, according to the report by Davis and Woodford given below, the ore occurred in three places separated by faulting, in each place being underlain by thin-bedded red, green, and gray chert, and overlain by thick-bedded gray iron-stained chert and shale. The ore body was said to be 3 feet thick.

About 5 tons of high-grade ore is piled on the dump of a caved adit driven into the hill to the south near the east end of the property. The ore is a very high grade gray manganese carbonate, covered by thin films of black manganese oxides. It is cut by veinlets of pink rhodochrosite, and by veinlets of a brown cherty material. This is probably the type of ore which ran 50 percent manganese. Sandstone is exposed at the mouth of this particular tunnel, and the distance to the ore body cannot be determined. A pit 100 feet west of the tunnel reveals, on the dump, blocks of coarse-grained sandstone containing shale fragments.

One hundred feet southeast of the caved adit mentioned above is a group of cuts or stopes and another caved adit which has been driven into the hill toward the southwest. The dump of this adit contains fragments of sandstone, greenstone, and chert. One of the cuts reveals shaly sandstone on the north face, slumped over by hill creep. Loose blocks of massive gray to brown chert, somewhat manganiferous, occur in one of the cuts.

Two hundred and fifty feet northwest of the first mentioned adit is a bold outcrop of massive red and white chert, (probably the ''massive jasper'' described in the 1918 report). A cut into the north face of this outcrop exposes massive red and white chert cut by quartz veinlets and containing manganese oxide stains. Some fault gouge was seen. A cut on the southeast side reveals shale. To the northwest of the massive chert occurs first standstone, then a wide belt of diabase and greenstone, with minor amounts of chert. Float ore is said to have been found to the south.

Between 350 and 400 feet west of the massive chert outcrop is a caved adit extending 40° E. into the hill. This is probably the tunnel over 200 feet long mentioned in the 1918 report. Greenstone and sandstone are on the dump.

Seventy feet west of this caved adit is an irregular shaped pit 30 feet long. Only loose blocks of material are exposed on the sides. On the ground are a few small blocks of high-grade carbonate ore (gray, and brownish gray), cut by veinlets of pink rhodochrosite, and surrounded by fairly thick shells of black oxides. The specimens are very heavy. There are also some heavy pieces of reddish-brown ore, possibly neotocite, cut by veinlets of rhodochrosite, and altered to black oxides. The pit also contains large massive red chert boulders with manganese oxide stains.

At the northwest end of the property, 500 feet northwest of the last mentioned adit, is a series of small cuts or pits which do not appear to penetrate the regolith, but reveal loose blocks of manganiferous chert. Some float ore may have been obtained here.

Brereton Mine. (By E. F. Davis and A. O. Woodford, August 18, 1918.) The principal ore bodies have been found on the east part of the property. Here an open cut first exposed a body of carbonate ore. This ore had all been removed at the time of the authors' visit. In the north stope a small body of carbonate ore was found. This ore had also been removed, but the nature of the rocks above and below the ore could be determined. The overlying rocks are shale and a peculiar iron-stained chert. The chert is thick-bedded as compared with ordinary radiolarian chert, occurring in beds 6 to 18 inches thick. Small amounts of iron and manganese in veinlets cut the chert. On fresh fractures the chert is light gray. No radiolaria were seen. The shale alternating with the chert beds is apparently ordinary terrigenous shale. It occurs in beds 4 inches to 1 foot thick.

Below the ore body is a bed of thin-bedded red, green, and gray chert between 2 and 3 feet thick. The individual chert beds are from 1 inch to 1.5 inches thick. The shale partings are thin, but in appearance this chert is identical with ordinary radiolarian chert. It contains a few round spots which may be radiolarian skeletons. Underlying the thin-bedded chert are sandstone and shale of the sort common to the Franciscan group.

In the central stope a body of gray carbonate ore was exposed. The relations are the same as those just described. Over the ore lies thick-bedded chert with gray shale. Under it is thin-bedded chert, which is separated from the ore by a foot of soft shaly material. The ore is a fine-grained gray carbonate cut by numerous veinlets of pink rhodochrosite which are later than the primary gray carbonate. The rhodochrosite is 3 feet thick and is cut off on both sides by faults. The three places in these workings where ore has been encountered appear to be portions of one ore zone displaced by faulting. The hanging wall and footwall of the ore are the same in all these places. The ore bodies have shown similar attitudes, striking northeast and dipping to the west at angles of about 30°.

No. 5. Buck Ridge Prospect. (By E. F. Davis and A. O. Woodford, August 4, 1918.) Charles B. Walsh and B. Mendenhall of Bachelor, Lake County, own the Buck Ridge manganese prospect on Cow Mountain in sec. 17, T. 15 N., R. 11 W. It is described in the location notice as being on the south side of Cow Mountain about three-quarters of a mile west of Bald Knob near the Lake County line.

No. 6. Callizo Prospect. (By Frank S. Simons, May 1942.) The Callizo prospect is in sec. 33, T. 13 N., R. 12 W., 7 miles southwest of Hopland, on the property of Salvador Callizo of Hopland. The prospect is half a mile from a good road, on the crest of the ridge south of Mr. Callizo's ranch house. The prospect is now owned by S. V. Frome of Hopland.

The ridge is composed of thin-bedded red chert striking about N. 30° W. A small cut exposes a 6-foot bed of manganiferous brown chert, which can be traced intermittently for 100 feet up the ridge. The ore is a dull brown siliceous rock, oxidized on fracture surfaces, the oxide usually being no more than a thin film. The ore bed is at least 6 feet thick in the cut, and the total thickness is nowhere exposed, but outcrops farther up the ridge appear to be very siliceous.

The best ore seen, in the open cut, contains about 35 percent manganese and a large amount of silica. The average ore has perhaps 25 to 30 percent manganese. The ore farther up the ridge appears to be very low in grade, mostly less than 10 percent manganese.

No. 7. Cinco de Mayo Claims. (By N. L. Taliaferro, October 26, 1917.) The Cinco de Mayo claims are in sec. 27, T. 24 N., R. 11 W., on the face of the cliff above Blands Cove. They are situated N. 65° W. from D. D. McLaughlin's cabin. The locators are C. V. Brereton, M. G. Morrison, and W. R. Foster of Covelo.

Several hundred feet up on the cliff, which here trends N. 50° E., is an outcrop of highly contorted thin-bedded chert containing a layer of manganese carbonate 8 to 20 inches thick. This layer is parallel to the bedding of the chert and follows it in all its contortions. This outcrop is a half to three-fourths of a mile southwest of the outcrops on D. D. McLaughlin's claims (Mendocino 35).

The manganese carbonate rock is brownish gray to pinkish and of fine to medium grain. It has been recrystallized slightly. Veins of quartz and rhodochrosite are numerous and the rock is stained with malachite. Small patches of a copper mineral which appears to be bornite, are present, usually in or near the quartz veins. The quartz veins cut the chert and manganese carbonate alike, suffering no deflection when they pass from one rock to the other. The carbonate layer thins toward the southwest. It could not be followed in that direction because of the steepness of the cliff. In general the carbonate ore is coated with a thin film of black oxide.

About 150 feet northeast of the last exposure of manganese carbonate is a small dike of serpentine cutting sandstone and shale. The dike trends northwest. This serpentine is greenish-black to black, dense, and homogeneous. It probably is derived from a rather rapidly cooled peridotite, and is an apophysis of the larger serpentine mass previously mentioned. The sandstone and shale are both cut by veins of albite, calcite, quartz, and natrolite (?). These veins become thicker and more numerous as the contact is approached and seem to be due to the peridotite intrusion. At a distance of 100 feet from the dike, quartz veins only are found.

Much float of carbonate ore is found on the talus slope below the cliff and it is probable that if the cliff were thoroughly prospected, other layers of ore would be found. Between 70 and 80 tons of ore is in sight in the cliff and in float on the talus slope. The secondary quartz veining materially increases the silica content.

Float of chert carrying numerous minute patches of manganese carbonate was found. Also float of a brown, resinous manganese-bearing opal (?) is abundant here. This opaline material is veined with rhodochrosite, quartz, and inesite (hydrous silicate of manganese and calcium).

No. 8. Cleveland (Homestead) Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 42, 1918.) R. L. Cleveland of Ukiah owns a deposit in sec. 13, T. 16 N., R. 12 W., 3 miles east of the railroad station at Calpella, on the Potter Valley road. A small kidney of hard black oxide has been exposed by an open cut for a width of about 2 feet on a contact of jasper and black shale. Considerable float covers the steep side hill on which this deposit occurs, and the jasper beds are extensive, but no other ore bodies were seen. No ore has been produced here, but a fair body might be developed by further work.

No. 9. Consolidated Claims (Big Jim, Black, Lone Indian, Mount Sanhedrin deposits). (By Frank S. Simons and Ivan F. Wilson, June 12, 1942. The Consolidated claims, 10 in number, are in sec. 30, T. 20 N., R. 11 W., on the northeast slope of the ridge of which Impassable Rock is a part. They were located by A. C. Hauer and William R. Hubbard of San Bernardino. The claims are 2.5 miles by trail from Rackout Spring, which is 27 miles by road from Willits, the nearest railroad shipping point. Some work was done on these claims in 1917 and 1918, when they were known as the Black Leases. Recent work has been confined to 4 of the 10 claims. No ore has been shipped yet, and none of the prospects are active. The Consolidated claims lie on two ridges which trend slightly east of north from Impassable Rock. Claims Nos. 1 to 5 are on the east ridge, Nos. 6 to 9 on the west ridge, and No. 10 near the south junction of the two ridges. The following is a description of the individual claims:

In the Consolidated No. 1 claim, a shaft 10 feet deep exposes 6 feet of siliceous manganese oxide ore. The float in the vicinity is almost entirely sandstone. Some of the ore consists of soft black oxide in white chert, but most of the ore is manganiferous chert containing 25 to 30 percent manganese. Five tons of ore is in sight, but the lack of any further exposures makes the estimation of additional amounts difficult. Some of the ore near the surface consists of angular chert fragments cemented by manganese oxide. The amount of this type of ore is, however, very small. This claim was apparently the former Lone Indian claim.

Consolidated No. 2 claim was not found.

Consolidated No. 3 claim is 625 feet by trail northeast of No. 1, and trends 600 feet west and 900 feet east from the workings. There are two open cuts here. The upper cut has a shaft 20 feet deep, exposing siliceous manganese oxide ore. The thickness is not known, as the walls are not exposed, but the ore body is at least 6 feet thick. The country rock is white chert, but the attitude of the rock is obscure. Twenty tons of ore, containing about 20 percent manganese and 60 percent silica, are piled on the ground nearby.

An open cut 40 feet deep lying 60 feet below the first cut exposes 6 to 8 feet of siliceous oxide ore striking N. 30° W., and dipping 35° SW. The hanging wall is massive white chert, the footwall thin-bedded grayish shaly chert. The rocks have slumped considerably. Large blocks of ore are found in the slumped part. The ore is manganiferous chert averaging about 25 percent manganese and 50 percent silica. A small amount of high-grade psilomelane ore lies along fractures. Some 50 tons of ore has been piled nearby.

The relation of the ore bodies in the two cuts is not known, but the attitude of the rocks in the lower cut suggests that the ore is not continuous between them. The ore along the strike down the ridge is siliceous, the southeast extension of the ore bed being covered by overburden. The hanging wall is not well defined, the ore merely becoming more and more siliceous. This claim is the original Big Jim claim.

Consolidated No. 4 claim is 550 feet by trail northeast of No. 3, and extends 600 feet west and 900 feet east of the workings. Here a bed of manganese oxide ore is exposed along the strike for a distance of 25 feet. The strike is N. 70° E., the dip, probably nearly vertical. The ore bed is faulted against sandstone at the east end, and appears to lens out at the west end. The ore bed is 3 feet thick at the thickest part, near the west end, and decreases to practically nothing at the east end.

The ore is soft black oxide containing many brown and buff leached silica cores, and it occurs in white chert. The average ore contains 25 to 30 percent manganese, with some high-grade ore containing probably as much as 45 percent manganese. The amount of this grade ore is small—100 tons at most.

The discovery monument of the Consolidated No. 5 claim is 600 feet east of the east boundary of No. 4, the claim extending 600 feet west and 900 feet east of the discovery monument. The claim was located October 2, 1930. No ore is exposed at the monument.

Consolidated No. 6 claim was not found.

The Consolidated No. 7 claim lies in the West Ridge. The claim extends 750 feet east and west from the workings. It was located June 27, 1939. An open cut 60 feet long exposes 3 feet of siliceous manganese oxide ore in white chert striking N. 60° W., and dipping nearly vertically. The ore is 3 feet thick in the face; the floor is not exposed. The total length of the ore exposure is 10 feet, and was probably altogether about 40 feet. The ore is variable, ranging from nearly pure chert to high-grade pyrolusite containing perhaps 45 percent manganese. The high-grade ore occurs as a streak 1 foot thick near the west wall. Five tons of ore, averaging about 30 percent manganese, are piled near the dump. As the floor of the cut is not exposed, the amount of ore remaining in the ground is uncertain.

The Consolidated No. 8 claim lies 200 feet southwest of the cut at No. 7. Here an open cut exposes 3 feet of manganese oxide ore in faulted buff shaly chert. The ore bed strikes N. 30° W., and dips nearly vertically, but is faulted off 7 feet below the surface so that it does not crop out, the only surface indication of ore being a thin streak of oxide along the east wall, which is a fault wall. The chert is contorted and faulted.

Ten tons of ore, averaging 30 to 35 percent manganese are on the dump. The amount of ore in the ground is unknown, as the only exposure is a face 3 feet wide and 3.5 feet high, no ore being exposed in the floor. The severe faulting in the country rock, however, makes the chance of finding much more ore very poor.

The Consolidated No. 9 claim is south of No. 8, and was located on June 27, 1939. It trends northwest 1,500 feet from the discovery monument. The monument is on interbedded, white and brown chert striking N. 20° W., and dipping 30° SW. Manganese is present only as thin and irregular films of oxide along bedding planes. No ore is present.

The Consolidated No. 10 claim is near the junction of the two ridges, and was located July 1, 1941. The monument is on white chert striking N. 70° W., and dipping 85° NE. No manganese is present.

No. 10. Cooper Prospect. (By Frank S. Simons, May 21, 1942.) The Cooper prospect is in the SW¼ sec. 33, T. 12 N., R. 11 W., on land owned by F. M. Cooper of Santa Rosa. It is about 1 mile southeast of the Shaw and Matthews mine (Mendocino 47), half a mile from the nearest road, and 7 miles from Cloverdale on the Northwestern Pacific Railroad. The property was worked in 1918 but has been idle since.

An open cut 40 feet long exposes contorted red chert striking N. 10° E., and dipping steeply east. The red chert beds average 2 inches in thickness but some are 6 inches. The north wall of the cut shows 5 feet of siliceous manganese ore. The ore is a dull resinous reddish-brown material, probably neotocite, oxidized in places to a depth of 1 inch. The floor of the cut has been buried by loose rock and is not visible. Six tons of siliceous ore is piled on a nearby dump. The ore appears to come from the footwall of the main ore bed, the footwall being formed of white chert filmed with manganese. The ore in the main bed is estimated to contain

30 percent manganese. Fifty or sixty tons of ore is on various dumps and scattered along the trail to the prospect.

No. 11. Coursey Brothers Prospect. (By N. L. Taliaferro, October 17, 1917.) The Coursey Brothers prospect is on the south side of Darby Ridge, 150 feet below the crest, on land belonging to J. W. Coursey, in sec. 4, T. 18 N., R. 13 W. A small open cut has been made in a chert band. The strike is roughly east, and the dip is 20° N. The open cut is only a few feet deep and exposes thin-bedded red chert, much stained with manganese. Manganese oxides also occur in small veins and in seams along small slips. This is the only prospect seen on Darby Ridge that is worthy of further development.

In one of the tunnels on the crest of the ridge the contact between chert and greenstone is well exposed. The contact is parallel to the bedding in the chert which dips 25° S. The rocks have moved along the contact and the greenstone is much decomposed. The greenstone is very fine-grained along the contact and the individual constituents cannot be made out. A few feet from the contact, altered feldspar phenocrysts are seen. The chert is much crumpled and fractured and is intensely coated with manganese. Manganese stains are also found in the greenstone near the contact. The manganese films are generally found in chert that has been intruded by, or is in the neighborhood of, intrusive greenstone, and it is probable that they are manifestations of the action of the instrusive on the chert.

No. 12. Dorn Prospect. (By F. S. Hudson and N. L. Taliaferro, October 16, 1917.) The Dorn prospect is on the west side of Foster Mountain, and is south-southwest of the Hinrichs property (Mendocino 21). It is owned by C. A. Dorn, and is under lease to J. E. Page of San Francisco. The present workings are in the S½SE¼ sec. 28, T. 19 N., R. 12 W., and consist of a few open cuts in the soil, which is here 6 to 10 feet deep. Three small open cuts do not expose ore in place or bed rock. No ore has been found in the upper cut, but large blocks of manganese stained chert and some good ore have been found in the lower cuts. The ore occurs as fragments and small blocks of soft, earthy ore scattered through the soil and as shells of ore surrounding blocks of leached chert. The ore consists of more or less impure psilomelane, pyrolusite, and wad. About 15 tons has been mined here.

No. 13. Faucher Mine. (E. F. Davis and A. O. Woodford, August 8, 1918.) The Faucher mine is owned by Mrs. G. P. Beck of Fetters Springs and is operated under a lease by J. A. Faucher of San Francisco. It is in the SE¼SW¼ sec. 22, T. 17 N., R. 12 W., near the summit of a small hill east of the divide between Potter Valley and Redwood Valley. It is 4 miles by road from Redwood Station to the mine. Hauling to Redwood Station costs about $2 a ton over this road.

The ore occurs in lenses enclosed in thin-bedded red radiolarian chert. The ore is underlain everywhere by a massive red chert which varies in thickness from 1.5 to 5 feet. This chert contains numerous radiolarian skeletons. It is stained black on joints and fracture cracks by manganese oxide. Scattered through it are irregular patches of white porous silica. This chert probably contains 10 percent manganese. In places the massive chert on the footwall side of the ore body shows a rude banding that runs parallel to the bedding of the enclosing chert. Some of the ore is overlain by thin lenses of massive chert identical with that below it, but in other parts of its course, thin-bedded radiolarian chert rests directly on the ore body. The ore bodies and accompanying massive chert form an ore zone that is essentially parallel to the bedding of the enclosing thin radiolarian chert. These bodies strike N. 20° E., and dip 50° E. The maximum thickness of the ore exposed is 1 foot. Usually it is only a few inches thick.

At the surface outcrop a small seam of ore was found above a body of massive chert. This seam was followed down in a pit 5 feet deep. A tunnel was started 20 feet below the surface outcrop, continued along the strike of the chert for 50 feet until it reached a point below the open cut. A raise was then made until the ore was encountered and a drift about 20 feet long run along the ore body.

The ore is steel gray in color, with a dull metallic luster and apparently consists largely of psilomelane. It almost invariably shows a well marked lamination. Layers of hard "steel" ore 0.1 to 0.5 inch in thickness alternate with thin partings of soft black or dark-reddish material. The lamination of this ore is parallel to the bedding of the enclosing chert and the walls of the ore body. The ore of this deposit contains 50 percent manganese and less than 5 percent silica. Three tons were taken out and represented the entire volume of the ore lens.

No. 14. Fischer Prospect. (From files of U. S. Geological Survey, 1918.) A small deposit of little value is said to be owned by Herman Fischer of Calpella. Perhaps it is the same deposit as the Fisher prospect (Mendocino 15).

No. 15. Fisher Prospect. (By E. F. Davis and A. O. Woodford, August 5, 1918.) A. Fisher of Calpella reports a prospect of manganese on his ranch in Redwood Valley, in sec. 9, T. 17 N., R. 12 W. It is 1.5 miles from the county road by a very steep rough road, and 8.5 miles in all to Redwood Rail Station. Here a body of thin-bedded radiolarian chert is stained with black manganese oxide. At one place the staining is a little more pronounced than usual and some of the loose pieces of chert are coated with considerable manganese oxide. The amount of manganese is negligible and the prospect is valueless.

No. 16. Foster Mountain (Busch, Independent, Lucky Boy) Mine. (By Frank S. Simons, May 23, 1942.) The Foster Mountain mine, formerly known as the Independent or Busch mine, is 16.4 miles east of Willits, in sec. 4, T. 18 N., R. 12 W. The last 3.4 miles of the road is rough, but is being graded at present and should be in good shape in the near future. The mine is owned by the Car-Gor-Van Minerals Company, the members of which are I. Carpenter, E. C. Gordon, and B. W. Van Horn of Ukiah.

The deposit was discovered in the nineties, but apparently little work was done at that time. It was worked from 1916 to 1918, and, according to Mr. George Busch, who kept the books for the mine at that time, 4,500 tons of ore averaging more than 45 percent manganese and less than 7 percent silica, was shipped. This ore was removed from two open cuts, and from a tunnel at the northwest end of the ore zone. The mine was worked for a short time in 1925, and about 1,000 tons of ore was taken from a drift and stope along the continuation of the ore body exposed in the upper open cut. The core mined in 1925 was carried by a chute 1,100 yards downhill to the bottom of the canyon and loaded into wagons there, from where it was trucked 15 miles into Willits. The ore is said to have cost $10 a ton to place on the cars at Willits.

The deposit occurs in a belt of brown and buff chert striking northwest and dipping southwest, generally at a high angle (fig. 2). The chert is contorted and very much broken by numerous faults, much of the chert being so brecciated that blocks larger than 2 or 3 inches in diameter are rare. Most of the ore mined has come from two large open cuts, which are now somewhat caved. Very little ore is exposed in either cut, so the relations of ore and wall rocks are not evident, but, in general, the footwall appears to have been thin-bedded brown or buff chert, considerably leached and very soft and punky; the hanging wall is massive brown chert, commonly carrying manganese oxide as thin films on fracture surfaces. The ore appears to lens out at the west end of the west open cut, a thin wedge of ore remaining at the end of the cut in the shaft. Relations at the east end of the cut are obscure, but the ore bed seems to be faulted off and to reappear where the east cut now is.

Beginning 65 feet from the portal of the tunnel shown in cross section AA, figure 2, ore is exposed in the floor for a distance of 15 feet. The structure here is complicated by faulting, but as the tunnel walls are lagged, little can be seen. This ore is a continuation of the ore body mined in the east cut, and the ore bed has been followed for 30 feet along a drift and a stope southeast of the tunnel. In the drift the ore bed is at least 5 feet thick, as ore occurs in both walls, the roof, and part of the floor.

Three general types of ore are on the main dump. Pyrolusite and psilomelane are present in small amounts, along fissures and on fracture surfaces. There is a considerable quantity of hard siliceous oxide ore, cut by many tiny quartz veins. This ore appears to be intimately mixed manganese oxide and silica. Considerable partly oxidized brown carbonate ore is also present. The carbonate is massive, fine-grained, and light brown in color. One small vein of rhodochrosite was seen. The present owners have been discarding carbonate ore while sorting the dump.

The only ore exposed in the open cuts is hard blue black psilomelane, which probably is the ore that was shipped. In the short drift the ore is also psilomelane, so the source of the carbonate ore and the hard siliceous ore is not known.

Two hundred feet northeast of the workings is a small outcrop of thin-bedded buff chert striking east. Interbedded with the chert are at least 2 feet of fair ore, the total thickness being unexposed. Some of the ore here is high grade psilomelane. This exposure has not been developed, and, as no rock crops out between it and the present ore bed, the relations are not known. It is probably a separate ore body, but the size is impossible to estimate.

Foster Mountain Mine. (By Max D. Crittenden, Jr., August 12, 1944.) In 1941, 1942, and 1943, several attempts were made to operate the Foster Mountain mine by reopening the old adits and stopes. The ground proved so difficult to hold, however, that only a small amount of ore was produced. In the spring of 1944 the entire area of the old workings was exposed by a deep T-shaped bulldozer cut (fig. 2). The ore in pillars or caved areas was recovered in the process. The floor of the deepest cut is level with the lowest adit that was reopened. Another adit was located 50 feet below the floor of the open cut. About 300 tons of ore was recovered in this way. The average grade was 47.5 percent manganese and 23.8 percent silica.

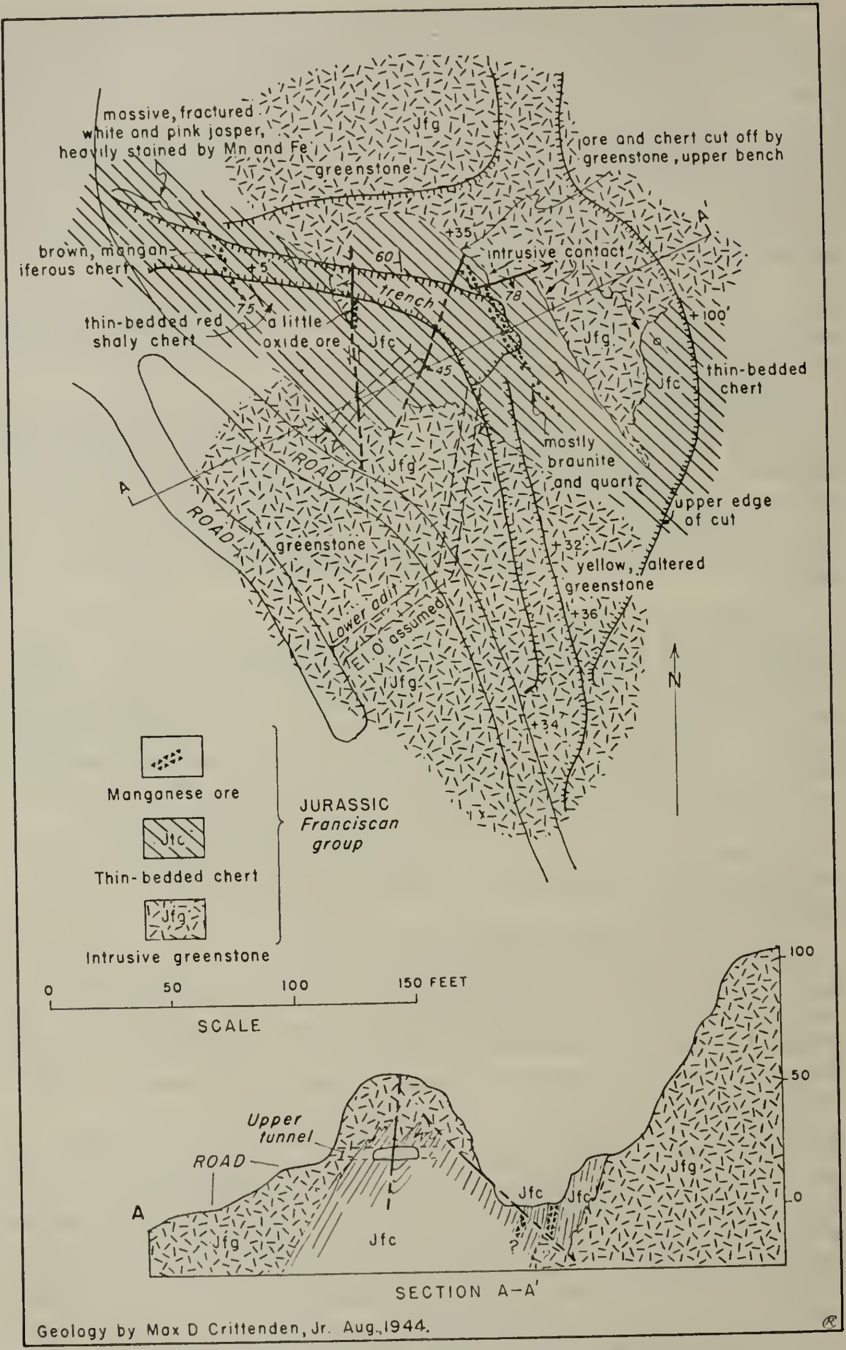
massive, fractured white and pink jasper, heavily stained by Mn and Fe
Jfg
greenstone
ore and chert cut off by greenstone, upper bench
A'
+35
brown, manganiferous chert
+5'
60
intrusive contact
trench
78
75
thin-bedded red shaly chert
a little oxide ore
Jfc
45
+100'
Jfg
thin-bedded chert
Jfc
mostly braunite and quartz
ROAD
Jfg
A
ROAD
upper edge of cut
greenstone
+32
yellow, altered greenstone
+36
Lower adit
El. 0 assumed
Jfg
N
+34
Manganese ore
Jtc
Thin-bedded chert
Jfg
Intrusive greenstone
JURASSIC
Franciscan group
0
50
100
150 FEET
SCALE
Upper tunnel
ROAD
A
Jfg
Jfc
Jfc
Jfc
?
Jfg
100
50
0
SECTION A–A'
Geology by Max D Crittenden, Jr. Aug., 1944.

FIGURE 2. Geologic map and section of the Foster Mountain mine, Mendocino County, California.

The primary ore in the main ore body is a massive, dense black mixture of a manganese mineral and silica. This mineral resembles braunite from the Fort Seward mine. The average grade of this material is 40 to 45 percent manganese.

No. 17. Graham Prospect. (By Spangler Ricker, 1942.) The Graham prospect is in T. 20 N., R. 14 W., 3 miles south of Farley. It is said to be owned by Mrs. Vollie Graham of Hopland. The deposit consists of a small knob of ore, a sample of which assayed 38 percent manganese, 1.09 percent iron, and 36.28 percent silica.

No. 18. Hale Prospect. (By Frank S. Simons, May 21, 1942.) The Hale prospect is in sec. 24, T. 12 N., R. 11 W., about 1 mile east of the Shaw and Matthews mine (Mendocino 47), and is on land owned by Mrs. Fred Hale of Cloverdale. The property has been idle since 1918. It is 1 mile from the road to the Shaw and Matthews mine, and 8 miles from Cloverdale on the Northwestern Pacific Railroad.

A band of thin-bedded red and brown chert can be traced more or less continuously for 400 feet in a general north direction. At the north end of the outcrops a short tunnel and drift expose an irregular bed of manganiferous brown and white chert striking N. 30° W., with variable dip to the southwest. The best of the exposed ore contains less than 20 percent manganese; it is high in iron and silica.

An open cut 20 feet in length is 200 feet south of the tunnel along the strike of thin-bedded red chert. A small amount of porous red chert with manganese films on various surfaces is piled on the dump. Two hundred feet farther south a short tunnel exposes 5 feet of manganiferous brown chert. The best ore seen was probably not over 25 percent manganese, principally brown manganiferous opal (neotocite), oxidized near the surface. Five tons of this brown ore is piled on the dump. Fifty feet south of this tunnel an open cut exposes a dip slope of red chert, with the manganese-bearing bed 2 feet thick and very near the surface of the ground. West of the cut the slope of the ground steepens and the ore bed has been eroded away.

No. 19. Harms Prospect. (By Ivan F. Wilson, June 8, 1942.) A prospect belonging to Henry Harms of Willits is about 1 mile north of the Foster Mountain mine (Mendocino 16), which is 16.4 miles east of Willits. The prospect is in sec. 34, T. 19 N., R. 12 W. It is reached by a poor road extending southeast beyond the Foster Mountain mine toward the Lazy Moon Ranch, then branching north for a total distance of 2.5 miles. A better road is being constructed northwest of the Foster Mountain mine. When this road is finished, the distance from Willits will be 17 miles by fairly good road.

The prospect is in a chert lens exposed for a length of 130 feet and width of 30 to 40 feet. The chert, together with 20 to 30 feet of overlying sandstone and shale, is surrounded by greenstone. It forms a resistant knob on the crest of a ridge trending southwest, and is fairly well exposed. The chert is intricately broken by small faults with displacements ranging from 2 inches to 15 feet. Most of these faults trend northeast across the strike of the chert, and dip northwest. The chert itself strikes N. 30°-35° W., and dips 40° to 55° NE. into the slope. The faults have a general relative horizontal displacement of southwest on the northwest side. Assuming the movement to have been vertical, the faults would be normal faults; however, the movement may have been horizontal or oblique.

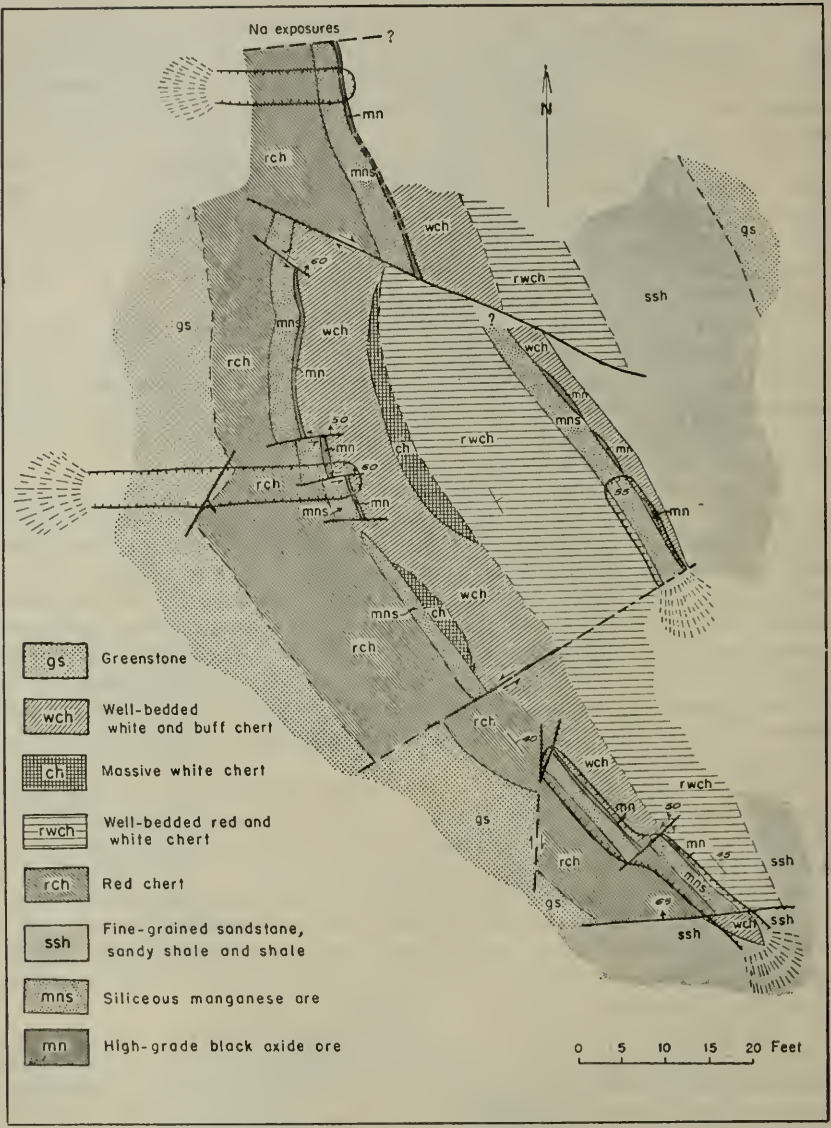
No exposures
?
mn
mns
rch
wch
rwch
gs
ssh
N
ch
60
50
55
40
45
65
gs Greenstone
wch Well-bedded white and buff chert
ch Massive white chert
rwch Well-bedded red and white chert
rch Red chert
ssh Fine-grained sandstone, sandy shale and shale
mns Siliceous manganese ore
mn High-grade black oxide ore
0 5 10 15 20 Feet

FIGURE 3. Map of the Harms Prospect, Mendocino County, California. *Geology by I. F. Wilson, 1942.*

Two separate ore bodies are interbedded in the chert. Both are beds of rather siliceous ore, overlain discontinuously by a thin zone of high-grade black oxide ore. The lower zone is the larger, being exposed discontinuously for a length of 130 feet. It is commonly displaced by faulting, along with the surrounding chert (fig. 3). The main part of this bed is a siliceous black oxide ore, containing much white and red chert. Some of it is merely a manganiferous chert. It is estimated that this bed averages 15 to 30 percent manganese, although higher-grade material could be obtained by sorting. The bed ranges in width from 18 inches to 4 feet, averaging about 3 feet. It is overlain over a considerable part of its length by a thin belt of high-grade black oxide ore. This belt is 2 to 6 inches thick, averaging about 4 inches. The ore is in general fairly soft, probably consisting mainly of pyrolusite with some psilomelane and possibly other oxides. It appears to contain very little silica, and the manganese content is estimated to average 45 percent.

An upper zone consists of 2.5 feet of siliceous ore probably averaging 15 to 30 percent manganese overlain by a few local lenses 1 inch to 6 inches wide, of high-grade black oxide ore similar to that described above. This ore body is exposed for a distance of 35 feet.

Development at present consists of two cuts 15 and 30 feet long at right angles to the strike, two other cuts 12 and 30 feet long extending along the southeast ends of the two ore bodies, and smaller shallow pits and cuts along various parts of the ore beds.

No. 20. Heughes (Frederica) Prospect. (By E. F. Davis and A. O. Woodford, August 8, 1918.) Showings of manganese occur on the land of Mrs. Effie M. Heughes of Calpella, in the NE¼SE¼ sec. 27, T. 17 N., R. 12 W. The prospect lies 4 miles by road from Redwood Station on the Northwestern Pacific Railroad. The property has been leased to A. S. Heughes of San Francisco.

The Noble Electric Steel Company opened a T-shaped cut having a total horizontal extent of 30 feet. The rocks exposed are considerably fractured. A thick lens of massive chert varying in color from yellow to red was exposed in the working. This lens is cut by numerous veinlets of black manganese oxide and contains small pockets of black oxide ore. No material is exposed here that would pay for shipment.

No. 21. Hinrichs Property. (By F. S. Hudson and N. L. Taliaferro, October 16, 1917.) The Hinrichs property is in the SW¼ sec. 22, T. 19 N., R. 12 W., on the north end of Foster Mountain on land owned by A. Hinrichs. In the northern part of the property, at an altitude of about 2,100 feet, blocks of manganiferous chert have been taken from the red soil. The exterior of many of the blocks has been altered to good manganese ore. About ten tons of ore of fairly low silica, but high iron content, have been mined and sacked. A shaft and trenches have failed to uncover the ore in place. The blocks apparently have come from higher up on the ridge, and a trench to bed rock, started up the ridge, should uncover the ore bed within a short distance. The large size and angular outline of the blocks show that they could not have traveled far. An analysis of an average sample is said to have run 19.5 percent manganese and 11 percent silica.

A second working is located on the main ridge at Foster Mountain, at an altitude of about 2,475 feet. It is 100 yards south of a point where the road crosses a saddle on the ridge. Here large boulders of chert, carrying a small amount of low-grade manganese ore lie in soil.

No. 22. Hopper Prospect. (By E. F. Davis and F. S. Hudson, July 27, 1917.) The Hopper prospect is 1 mile east of Potter Valley Post Office in the south center of sec. 16, T. 17 N., R. 11 W. Manganese ore occurs here in a block of chert which has been included in an intrusive body of greenstone of the Franciscan group. The chert has been metamorphosed by the action of the intrusive rock and has become massive, taking on brilliant vermilion and orange colors. In places a spherulitic structure has been developed. The manganese oxide occurs as veinlets cutting this altered chert, and in a few places the veinlets expand producing a small amount of siliceous ore.

No. 23. Impassable Rock Deposit (Rhodochrosite, Mount Sanhedrin). (By Frank S. Simons and Ivan F. Wilson, May 1942.) The Impassable Rock manganese deposit is in the SW¼ sec. 31, T. 20 N., R. 11 W., and the NE¼ sec. 6, T. 19 N., R. 11 W. It is on the southwest side of Impassable Rock, about 3 miles by trail from Rackout Spring, which is 27 miles from Willets, the nearest railroad point. The owners are said to be O. Haslett, L. Winchel, and O. M. Woodward.

Three small ore bodies lie in the face of Impassable Rock. One of these consists of a small block of high-grade slightly oxidized carbonate ore that appears to have been faulted into its present position. The other two ore bodies are seen, on close examination, to consist of heavily stained chert. The relationships of these ore bodies are obscure because of complex faulting and intrusion of greenstone in the vicinity. The ore bodies however are small. Numerous blocks of siliceous ore litter the talus slope at the base of Impassable Rock.

Just below the talus slope a small amount of carbonate ore is exposed in an open cut, and 50 feet northwest of this cut a block of carbonate ore is exposed in a low cliff face. No rock crops out between the two bodies of carbonate, but the ore is probably not continuous, as all the rock exposed shows considerable faulting. Blocks of the carbonate ore are found in the talus slope beneath the open cut. The ore is light-gray carbonate, cut by small veins of rhodochrosite.

The total amount of ore in sight is small, and most of the ore, especially the oxide ore, is of low grade. The prospects of developing a large body of oxide ore in the face of Impassable Rock are slight, as the small amount of carbonate ore below the upper talus slope indicates that no large amount of this ore will be found.

No. 24. Jumpoff Claims. (By Frank S. Simons, May 25, 1942.) The Jumpoff claims are in sec. 32, T. 23 N., R. 10 W., on government land. The claim was recently relocated by Elmer Bauer of Covelo. The road from Covelo to Willows runs within 600 feet of the deposit. The Jumpoff deposit was described by Davis and Woodford in August, 1918. A short tunnel has been driven under the exposed ore to cut it at depth, but no ore was found. The deposit appears to be a small fault block of ore completely separated from the parent ore body and containing not more than 50 tons of ore, of about 45 percent manganese. The country rock is badly faulted, and any effort to find the main ore body would be expensive.

No. 25. Knight Prospect. (By Ivan F. Wilson, July 11, 1942.) A prospect owned by Mrs. Mamie C. Knight, Sunny Brook Ranch, Willits, is 3 miles southwest of Willits, probably in sec. 30, T. 18 N., R. 13 W., or sec. 25, T. 18 N., R. 14 W. It may be reached by driving along the highway south of Willits for 2 miles, then turning west just before reaching the Sunny Brook Ranch. One proceeds along this road to the west for 0.7 mile where an old wagon road turns to the northwest, crossing Baechtel Creek. The prospect is 0.8 mile west along this wagon road, now impassable to automobiles, on top of a hill at an altitude of about 1,850 feet.

The only development at this prospect is a small pit on the top of the hill. In this pit siliceous oxide ore is exposed. The best material is soft and punky, containing yellow cores of silica averaging perhaps 35 percent manganese. Most of the material now exposed contains large amounts of white chert, and probably contains 10 to 20 percent manganese. The ore bed is 2 or 3 feet wide. The attitude in the pit could not be determined. However, 20 to 30 feet west are some large outcrops of massive to thick-bedded white chert which strike N. 70° E., and dip 60° NW.

No. 26. Leap Prospects. (By E. F. Davis and A. O. Woodford, August 24, 1918.) H. Leap of Laytonville has several manganese prospects on his property in the northern part of sec. 11, T. 22 N., R. 15 W., 20 miles from Longvale by road. The workings consist of three small pits sunk on manganese-stained outcrops. The manganese occurs in association with iron oxide in schist. The nature of the schist varies from bright green to a typical blue glaucophane schist. At places in this schist are layers containing large amounts of iron in the form of specular hematite. The flakes of specular iron are parallel, giving a schistose structure to the ore. Some of this schistose iron ore contains bands and streaks of quartz and glaucophane. A few small bodies of nearly pure psilomelane are present but they are of no importance since none contains more than a few ounces of manganese ore. A sample of ore contained 10.9 percent manganese, 43.5 percent iron, and 32.3 percent silica.

No. 27. Leach Lake Mountain (Line Gulch) Claims. (By N. L. Taliaferro, October 26, 1917.) C. V. Brereton and M. G. Morrison have a claim on Leach Lake Mountain and one on Line Gulch on the northwest side of the mountain, probably in sec. 16 or 21, T. 24 N., R. 11 W. These claims were not visited, but a specimen of the ore from the Line Gulch claim was obtained from Mr. Morrison. This is a very good grade of gray carbonate ore similar to that from the Cinco de Mayo (Mendocino 7) claims. No development work has been done on either of these claims.

No. 28. Leona Deposit. (From files of U. S. Geological Survey, 1918.) The Leona deposit, in the NE¼ sec. 27, T. 17 N., R. 12 W., a short distance south of the Thomas mine (Mendocino 55) is owned by J. L. Taylor et al. of Ukiah and is leased to the Noble Electric Steel Company. Production of 100 tons of manganese ore has been recorded.

No. 29. Liberty Claim. (By E. F. Davis and F. S. Hudson, July 26, 1917.) The Liberty claim was located by F. W. Keeney and lies in the SW¼ sec. 15, T. 17 N., R. 12 W. The discovery monument is situated on a prominent mass of radiolarian chert, known as ''Black Rock.'' The chert is red in color, has numerous shale partings, and is cut by small fissures filled with manganese oxide. No ore body is apparent here and no work has been done.

No. 30. Linser Mine. (By Max D. Crittenden, Jr., August 15, 1944.) The Linser mine is in sec. 32, T. 5 S., R. 5 E., 11.6 miles by airline southeast of Garberville. The property is owned by Chester Linser, and operated by Rae F. Helmke of Garberville. The property has been worked entirely by open cut methods, using a large bulldozer for stripping overburden, and exposing the ore bed. A small bulldozer was used to haul ore from the working face to a bin, in metal "buggies" consisting of an ordinary mine car mounted on 30-inch steel wheels. This system was devised to enable a number of men to work continuously along the ore face, breaking and sorting the ore into the "buggies" which are hauled away when full. The cut was 400 feet long, and reached a maximum depth of 75 to 100 feet below the original surface.

The Linser mine is on the steep western slope of the narrow ridge that extends south of Harris. The exposures are poor, as the effects of hill creep and minor landslides are strong. Consequently the original discovery consisted of a number of boulders and pockets of high-grade ore scattered along the hill in the general direction of the strike. These boulders became more abundant and more continuous as the zone was followed back into the hill. Finally the bedded character of the primary ore, and its relations became clear. The ore as shipped consisted of a mixture of hand-sorted ore averaging 35 percent manganese, and high-grade sorted ore averaging 50 percent manganese. The ore was produced by oxidation and enrichment of a bed of massive white manganiferous chert 4 to 6 feet thick and averaging about 10 percent manganese. This bed is 25 to 35 feet below the top of a lens of thin-bedded red chert of the Franciscan group that appears to be 100 to 150 feet thick. Sandstone was exposed in the cut above and below the chert. The general strike of the ore and the surrounding beds is N. 25° W., and the dip is 36° to 48° NE. Near the surface, however, the dip was greatly flattened by creep. The ore bed is cut by numerous small faults, mostly with displacement of less than 3 feet, which step the ore zone down to the southeast.

In August 1944 low-grade oxide ore was exposed in the bottom of the cut almost for its full length. This transitional material consists of a spongy or cellular silica framework containing powdery silica and clay, veined or replaced by manganese oxides. Along each of the small faults the increased permeability has so facilitated the leaching of silica and the introduction of manganese oxide, that a pocket of minable ore has been produced. In the south end of the cut where exposures are deepest, the partly leached material grades into massive waxy, white, yellowish or brownish primary manganiferous chert containing about 10 percent manganese.

In thin section, this primary material is a faintly anisotropic cloudy tan banded material with a refractive index of 1.535. It contains numerous radiolarian remains and scattered flakes of bementite parallel to the bedding. Locally it is recrystallized to a water clear quartz mosaic. Veins of rhodochrosite and bementite cut through both the original and the recrystallized areas. One small vein of hausmannite or braunite was observed cutting the manganiferous chert. The total production of this deposit to August 1944 is about 2,500 tons. By August 1944 the oxide ore in the central and southern parts of the pit had been entirely mined out, and the ore remaining at the north end was almost exhausted. The primary ore is manganiferous chert too low in grade to be of value.

No. 31. The Lone Tree Claim. (By E. F. Davis and A. O. Woodford, August 7, 1918.) The Lone Tree claim is owned by W. S. Graham of Largo. It lies in T. 14 N., R. 11 W., probably in sec. 20. It could be reached by building a road half a mile in length from the McCauley Ranch, which is 3 miles by road from Largo and 6 miles from Hopland. On this claim are two low knobs rising above the general slope of the mountain side. The area around these knobs is underlain by thin-bedded red and gray radiolarian chert. On each of these knobs is considerable manganese float lying in loose blocks. No outcrop in place was found.

The ore varies in character. A large part of it is soft black ore containing a considerable amount of silica in yellow to yellow-brown, iron-stained silica spherules. Some of the float ore contains solid blocks of gray chert embedded in a matrix of soft black rather porous manganese oxide. Other float consists of blocks of chert containing spherical cavities averaging a sixteenth of an inch in diameter. These blocks are heavily stained with manganese oxide. There are about 3 tons of float averaging about 25 percent manganese and 30 percent silica.

An open cut discloses a small body of sandstone at one point, but no other rock was discovered in place. The greater part of the exposed material is the surface cover of soil and small angular blocks of chert. Embedded in this surface material are numerous blocks of manganese ore. The float ore has been called ''bog ore'' probably because of its brecciated character, causing it to resemble certain deposits formed around springs where manganese oxide cements loose rock fragments in the soil. No spring is near here and the character of most of the float makes this interpretation seem unlikely. It appears probable that these blocks scattered on the surface and through the soil cover are derived from the breaking up of an ore body at the surface.

No. 32. Earl W. Long Prospect (Happy Four, Last Chance, Woodman Station). (By Ivan F. Wilson, July 4, 1942.) A prospect known in 1918 as the Earl W. Long prospect is located half a mile east of Woodman station on the Northwestern Pacific Railroad. It may be reached by proceeding a quarter of a mile due east from the station, across the Eel River, to a cabin and barn owned by Albert Geyer; thence a quarter of a mile up the slope to the southeast to the claim. The prospect is on the north flank of a steep ridge trending west. The nearest road is at Dos Rios 5 miles south along the railroad. The prospect is at an altitude of approximately 1,800 feet, about 1,000 feet above the river at this point. Ore could be hauled down to the river on sleds, and would then have to be transported across the river to reach the railroad. The shallowest river crossing in the near vicinity had a maximum depth of water of about 3 feet when visited by the writer (July 1942).

A claim notice found at the site of the original Earl W. Long claim was signed by John Vinton and Douglas MacMillan, dated January 12, 1942, the claim being called the Happy Four. The long direction of the claim (1,500 feet) was stated to be east.

Another claim notice was found at the Albert Geyer cabin, signed by George Fales and Albert Geyer, dated April 1, 1942, and named the Last Chance claim. The location notice was stated to lie 70 feet southeast of the quarter section corner on the west side of sec. 12, T. 22 N., R. 14 W. The claim was stated to run southeast 1,500 feet from that point. This claim would appear to overlap part of the other claim, since the workings found at the site of the other claim notice were estimated to lie within 1,500 feet southeast of the Geyer cabin.

On the site of what is thought to have been the original Earl W. Long claim are two old pits, on the north flank near the summit of a steep ridge that trends west. In one of these pits are several boulders of black oxide ore. On the south face of the pit is an exposure of well-bedded red and brown chert with shale partings. This chert strikes N. 65° W., and dips 35° SW.

About 100 feet down the slope to the northwest a new trench has been cut into the slope. This trench is 10 feet deep at the back but it exposes only a regolith composed of broken chert and greenstone fragments. Most of the slope below this point gives the aspect of being covered by a deep soil. Chert outcrops on the ridge just south of the pits, and is bordered to the northeast by greenstone. No manganese crops out here. Several large and small blocks of manganese float are found in the vicinity of the pits mentioned, extending down the slope for considerable distance. Probably 5 or 10 tons of ore is in sight here. Some of the ore is high-grade black oxide ore containing small cores and patches of white silica. One or two specimens composed of brown neotocite, cut by veinlets of rhodochrosite, were seen. A sample of the black oxide ore from this locality contained 56.3 percent manganese and 9.2 percent silica.

No. 33. F. J. Long Prospect. (By Ivan F. Wilson, July 6, 1942.) A prospect known in 1918 as the F. J. Long prospect is on land now belonging to a Mr. Terry of Covelo. The prospect is in sec. 1, T. 24 N., R. 14 W., 2 miles west of Mina. It is reached by proceeding 1.1 miles by road west from Mina, then branching off to the north 1 mile to the Terry ranch. The prospect is reached by foot about a quarter of a mile northeast of the ranch house. It is in a grass covered area with a gentle slope toward the west. Mina is 20 miles by road north of Covelo. The total distance by road from the prospect to the nearest shipping point, Dos Rios on the Northwestern Pacific Railroad, is 38 miles. A road has been surveyed but never constructed from Mina to the railroad along the Eel River to the west, a distance of 6 miles.

Two main workings are on this prospect, 250 feet apart on each side of a low, gentle ridge sloping toward the west. South of the ridge a trench 50 feet long has been dug N. 50° E. into the slope. Near the mouth of the trench is exposed thin-bedded sandstone and shale striking roughly northwest and dipping northeast into the hill. On the northeast face of the cut is thin-bedded white and buff chert. About 10 tons of manganese ore was obtained from the cut and is piled by its side. It is black oxide ore with cores and patches of white silica, estimated to contain 35 to 40 percent manganese.

A second pit, 250 feet across the ridge to the northwest, exposes 2 feet of siliceous manganese ore. The enclosing rock appears to be thin-bedded white to buff chert. The ore here is more siliceous than in the first trench.

Up the slope to the northeast from the last mentioned pit is an exposure of thick-bedded, impure shaly gray chert, striking N. 15° W., and dipping 45° NE. Greenstone is exposed in a few places east and south of the prospect. Chert float occurs along the ridge between the two main workings but no rock crops out. Along the west end of the ridge are exposures of quartz-mica schist, apparently developed by the metamorphism of sandstone.

No. 34. McClendon Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 44, 1918.) A small deposit of manganese is on the Walter McClendon Ranch 5 miles northeast of Calpella, probably in sec. 1, T. 16 N., R. 12 W. It adjoins the W. P. Thomas (Mendocino 55) property on the south. A carload of manganese ore is said to have been shipped from here during 1917. No work has been done since.

No. 35. McLaughlin (Blands Cove) Claims. (By N. L. Taliaferro, October 21, 1917.) D. D. McLaughlin of Covelo has nine claims in this locality, probably in sec. 26, T. 24 N., R. 11 W. About 0.6 mile northeast of, and about 1,200 feet above, Mr. McLaughlin's cabin at Blands Cove, a bed of manganese ore 6 to 9 feet wide is exposed in a small open cut for a distance of 25 feet along the strike. The hanging wall consists of crumpled and somewhat metamorphosed, thin-bedded chert; and the footwall, though not well exposed, is apparently massive chert. The strike of the chert and the lens of ore is N. 45° W., and the dip 53° to 60° NE. Toward the north end of the exposure the lens thins and is only 6 feet wide where it disappears under a heavy mantle of soil. Toward the southwest end of the exposure the lens likewise thins and is broken by a fault, the chert and shale being much folded and crumpled. Small blocks of manganese ore occur in the broken chert.

The ore exposed at the surface is largely black manganese oxide of excellent quality. The oxidation extends to a depth of several feet but nodular masses with unaltered cores of manganese carbonate are common in the oxidized zone near the surface. Manganese carbonate will be probably encountered within a short distance from the surface. The carbonate, as seen in the unoxidized cores, is a dense brown rock cut by small veinlets of pink rhodochrosite.

About 150 feet horizontally and 100 feet above the locality just described is another exposure of manganese ore. No development work has been done and exposures are not good but the manganese seems to occur as a lens 5 feet wide. Here the footwall consists of veined and altered thin-bedded chert and shale, and the hanging wall of massive greenish chert, the relations being the reverse of those in the lower deposit. These two outcrops may be a part of the same lens, which has been folded and overturned, or it may be a different lens. The upper deposit strikes N. 65°-70° E., and dips steeply north. The ore exposed on the surface is a mixture of psilomelane, pyrolusite, and brownish black earthy "wad," and is of excellent quality. The ore bed is 5 feet wide and is traceable by float for at least 30 feet. It is cut off on the southwest by a small fault.

About 250 yards west-northwest of this deposit is a small body of siliceous ore in massive chert, which is much broken and faulted. The blocks of ore are parallel to the bedding of the chert. The general strike is N. 80° E., and the dip is steep to the north. Even the best ore is siliceous and shows cores of leached chert. In places psilomelane (?) is seen to be a shell surrounding a yellowish porous skeleton composed of interlacing plates of silica slightly stained by iron oxide. In other places the cores are made up of pitted granular silica, the pits commonly having a rhombic outline. The most probable explanation of these small cavities is leaching of spherules or rhombs of manganese carbonate, the oxidation of which has produced the psilomelane. One or two thin veins of crystalline pyrolusite were seen cutting the chert. For about 125 feet, much of the chert is stained and filmed with manganese but little commercial ore is here.

Several hundred feet below this last locality and about 500 feet above Blands Cove is a massive outcrop of highly metamorphosed chert stained with manganese and iron oxide. Glaucophane and a green amphibole (?) have been developed in the chert and the manganese oxide has apparently been largely derived from the weathering of secondarily developed manganese-bearing minerals. Little if any commercial ore is exposed.

No. 36. Michaels, Roman, and Weeks Deposit. (Modified slightly from original report in California Min. Bur. Bull. 76, p. 44, 1918.) The Michaels, Roman, and Weeks deposit is located either in sec. 23 or 30, T. 23 N., R. 11 W., apparently north of the Brereton mine (Mendocino 4). It is owned by Charles Brereton of Covelo and was leased to Michaels, Roman, and Weeks in 1917. The deposit consists of manganese oxides in chert, along a zone several hundred feet in length. About 30 tons was taken from an open cut, but the deposit on the whole is low grade. No ore was sold.

No. 37. Montezuma Improvement Company Property. (By E. F. Davis and A. O. Woodford, August 30, 1918.) E. D. Baker of the Montezuma Improvement Company of San Francisco reports manganese prospects on the property of his company near Nashmead in T. 23 N., R. 14 W. The indications of ore are stains on chert.

No. 38. Morrison Prospects. (By N. L. Taliaferro, October 24, 1917.) Matthew G. Morrison of Covelo owns deposits in sec. 1, T. 22 N., R. 12 W., 1.3 miles south of the Covelo Ranger Station. On the steep west facing hillside above the Middle Fork of the Eel River and south of Mr. Morrison's house, a small open cut exposes a layer of siliceous manganese ore and manganese-bearing chert in thin-bedded red chert and shale. This layer is 20 inches thick. The strike of the red chert and the manganese-bearing layer is N. 80° E., and the dip is 65° to 75° S. The thin-bedded chert is somewhat crumpled and broken. The ore occurs in patches and in veinlets through the chert, which is veined with secondary quartz and is brecciated. Under the microscope the chert is seen to have been partly crystallized and to be made up of finely granular chalcedonic silica and quartz. Certain layers, rich in red iron oxide, contain small round to oval shaped areas composed of granular quartz. These areas are rarely more than 0.10 millimeter in diameter and the constituent quartz grains range between 0.01 and 0.03 millimeter in size. From their uniform size and shape it is reasonable to suppose that these areas represent radiolarian tests that have become crystallized. Small rhomb shaped grains of black manganese oxide (psilomelane?) are scattered through the chert, both as isolated grains and in patches. Slides from the Star Manganese prospect (Mendocino 52) show numerous rhombs of manganese carbonate in a chalcedonic groundmass which likewise has been partly recrystallized. These manganese carbonate rhombs seem to be due to the crystallization of spherules of manganese carbonate. The small rhomb shaped grains of manganese oxide described above probably represent the oxidation of rhombic grains of manganese carbonate formed by the crystallization of spherules of manganese carbonate. Occasionally the rhombic grains are more numerous in certain layers parallel to the bedding of the chert. The chert is also veined with manganese oxide (psilomelane?) which does not appear to have been derived in place from manganese carbonate, but seems to be due to solutions depositing manganese in the form of psilomelane along cracks in the chert. Quartz veins are numerous and appear to be slightly later than the veinlets of psilomelane. The quartz in these veins occurs as a mosaic of interlocking grains. The chert apparently was subjected to pressure, and a certain amount of crystallization seems to have taken place since the quartz veining, as some of the veins of quartz are sheared, and the grains are irregularly elongated in one direction.

Along the hanging wall of this siliceous layer is a zone of rather pure, somewhat pitted and slightly botryoidal psilomelane, which ranges from 2 to 8 inches in width. It lies along a zone of movement as shown by the brecciation of the siliceous manganese bed and of the thin-bedded chert. This rather irregular vein of psilomelane contains no residual cores of silica and its physical appearance is different from that of the psilomelane developed from the manganese carbonate of the chert, being bluish steel gray in color and very compact. It also contains a small amount of cinnabar in irregular patches, a mineral not seen in the siliceous bed. This vein seems to be a secondary concentration of manganese along a plane of movement. Descending waters may have taken manganese from the carbonate in the chert and deposited it along a fissure formed by minor faulting along one of the walls of the spherulitic manganese carbonate-bearing chert layer.

Fifty yards N. 65° E. and 40 feet above the last locality is another outcrop of the same layer exposed in a shallow open cut. Here the layer and the thin-bedded chert strike north 60° E., and dip 20° to 25° SE. The vein of pyrolusite along the hanging wall is only a few inches thick. At this locality no distinct footwall is present; the siliceous ore grades into barren chert. The bed is more siliceous here than at the first described locality. Apparently this deposit, with the exception of the vein of psilomelane, is due to the oxidation of minute spherules or particles of manganese carbonate scattered through the chert. To the northeast this layer becomes more and more siliceous, or rather the amount of manganese per unit volume becomes less, and the layer approaches more closely a normal chert. Whether or not it becomes richer in manganese in the opposite direction is uncertain as no exposures were seen to the southwest. The only commercial ore here is the small irregular vein of pyrolusite. About 5 tons of this type of ore is in sight. The siliceous ore would be valuable if some means of concentration could be devised.

M. G. Morrison also has a manganese claim in the NE$\frac{1}{4}$ sec. 7, T. 22 N., R. 11 W., about 1 mile southeast of the above described locality. This claim is located on a steep hillside with a slope to the south of 39° to 40°. Here a little low-grade manganese ore is associated with red and greenish chert. The strike is north and the dip is high to the west. Very little development work has been done and the rocks are not well exposed. The ground is covered with float of diabase and greenstone, but none was found in place. The chert is more or less brecciated and metamorphosed and the manganese occurs in small veinlets. Several small veins of well crystallized pyrolusite were seen cutting altered red chert. Films and stains of malachite are fairly numerous. No commercial ore is in sight here and the prospects are poor for finding a vein or bed of manganese ore.

No. 39. Nowlin Mine. (By E. F. Davis and A. O. Woodford, August 19, 1918.) The Nowlin mine is in the northern part of sec. 3, T. 22 N., R. 13 W., 3.5 miles west of Covelo near the summit of the ridge on the west side of Round Valley. It is owned by W. S. Nowlin, Charles Heminway, and Elmer Hurt of Covelo, and is on land owned by W. S. Nowlin. In 1942 the land was owned by a Mr. Von Kronsky of San Francisco. It was formerly leased to James E. Page of Willits but is now idle. The ore is hauled on sleds half a mile, then it is loaded on motor trucks and hauled to Dos Rios, a distance of 20 miles.

The ore zone is enclosed in thin-bedded red radiolarian chert and forms a nearly continuous stratum in the red chert, though in places it is offset by small faults. Its thickness varies between 2 and 7 feet. The ore zone is well exposed on both sides of a ridge in a series of open cuts and stopes. The strike of the ore zone and the enclosing radiolarian chert varies somewhat, extreme values being N. 20° E., and N. 50° E. The dip varies between 30° and 35° SW. The walls of the ore body are parallel to the bedding planes of the enclosing cherts.

The ore zone lies just above the basal contact of a body of red chert with a medium- to coarse-grained sandstone. This contact is clearly exposed at several places in the workings and in the natural outcrops. A thin bed of chert rests directly on a gently curving surface of coarse sandstone.

About 2 feet below the chert contact the sandstone contains numerous small lenses and nodules of chert. This chert is usually green but is pale pink in places. It seemingly contains no radiolaria. Some of the nodules are round and range in diameter to 2.5 inches. Others are larger but have the form of greatly flattened ellipsoids. Their diameters may be as great as 16 to 18 inches. The thickness is usually 1.5 to 2 inches. The nodules of chert in the sandstone show no tendency to lie along any definite horizon. The plane of their longer axes is invariably parallel to the bedding in the overlying thin-bedded chert. The chert that encloses the ore shows a marked tendency toward lenticularity.

Overlying the sandstone is a zone of thin-bedded chert. Owing to the wedging of some of the chert beds and in part to the thickening of others, the thickness of thin-bedded chert below the ore zone varies considerably. At one place only 6 inches of shale and chert lie between the sandstone and the ore zone. With increase in the number of lenticular beds the zone of intervening chert increases to a thickness of 2 feet in a distance of 6 feet. The maximum observed thickness of chert and shale below the ore is 6 feet. Overlying the ore zone is an undetermined thickness of red radiolarian chert and shale.

The ore zone itself is somewhat complicated in the arrangement and distribution of the various materials that compose it. The greater part of the ore is siliceous and the different varieties grade imperceptibly into one another. Most of the ore is banded, the bands running parallel to the general bedding of the formation and usually ranging from 0.1 to 0.2 inch in thickness. Bands of ordinary red radiolarian chert alternate with bands of carbonate ore. Bands of carbonate ore may alternate with bands of clear chalcedony containing numerous spherules of rhodochrosite. Some parts of the ore zone show thin strips of red shale separating bands of siliceous ore. Near the surface the ores become oxidized. The primary ore appears almost everywhere to be siliceous. The shipping ore was oxidized ore.

W. S. Nowlin reported two other prospects on his place near Covelo. When examined, these prospects were found to consist simply of stains of black manganese oxide in red radiolarian chert and shale. There is no indication of any ore body at either prospect.

No. 40. Ocean View Deposit. (By E. F. Davis and F. S. Hudson, October 14, 1917.) The Ocean View deposit is in the NE¼ sec. 34, T. 20 N., R. 12 W., at a point on the Henshaw Ranch called Ocean View. Here 3 feet of rather soft siliceous iron ore occurs within thin-bedded red radiolarian chert. Two feet above the iron ore, and separated from it by thin-bedded red chert, is a body of greenstone which contains a little manganese oxide on fracture cracks. The iron ore is massive, showing no tendency to bedding. It is cut by many fractures, which are so filled with manganese oxide that blocks breaking from these surfaces appear to be entirely black. A few small pockets of manganese oxide ore are found in this material, but never enough to be of value. The iron ore runs from 5 to 20 percent manganese—generally less than 10 percent. The silica content is about 40 percent.

No. 41. Pine Mountain (Pieta Creek) Prospects. (By Frank S. Simons, May 20, 1942.) The Pine Mountain prospects are in the NW¼ sec. 25 and the NE¼ sec. 26, T. 12 N., R. 10 W., on Pieta Creek 10 miles northeast of Cloverdale. The last 2 miles of the road are very steep, and a new road would have to be built if ore were to be trucked to Cloverdale. The prospects are on the land of Charles R. Adams and his sister, Mrs. Larson of Cloverdale.

A belt of thin-bedded brown, red, and green chert strikes about north along the east bank of Pieta Creek. A quarter of a mile downstream from Mr. Adams' home, along the east bank of the creek, is an exposure of landslide material 150 feet long, and as much as 50 feet thick. Scattered through the rubble are numerous small fragments of low-grade manganese oxide, the greater part of the material being red and brown chert, mixed with some brown sandstone. One tunnel 50 feet long was driven into the hillside in 1918, but according to Mr. Adams no ore was found. The nearest outcrop of rock in place is 150 feet up the hill, and no ore is visible there.

A quarter of a mile downstream and 100 yards east of the road a small pit has been dug in red chert, and a few pounds of good oxide ore are piled nearby. Two hundred yards north of the pit is an open cut 50 feet long, exposing a 2-foot bed of siliceous manganese oxide ore in thin-bedded brecciated red and brown chert. The floor of the cut is not visible, but Mr. Adams says that only a small amount of ore was removed. The ore on the dump is brown and dully resinous (neotocite), somewhat oxidized on the surface. A few small veins of manganese carbonate cut the brown ore. The best ore here contains less than 25 percent manganese and is rich in iron.

One mile downstream and 300 feet above the creek is a bed of manganiferous brown chert striking east and dipping 30° N. The chert is much sheared and faulted, and carries films of manganese oxide. One small pocket in the chert runs about 30 percent manganese, but the average grade is less than 10 percent. The bed is 2 to 8 feet thick and 125 feet long.

No. 42. Rhodes and Hurt Prospect. (By N. L. Taliaferro, October 1917.) The Rhodes and Hurt prospect is on deeded land belonging to W. D. Rhodes and G. H. Hurt of Covelo. It is in the W½ sec. 36, T. 23 N., R. 12 W., 5.5 miles east-northeast of Covelo, and 1 mile west of the Covelo Ranger Station. This prospect has not been developed. About 100 yards south of the county road is an outcrop of somewhat metamorphosed massive green chert stained and filmed with manganese. No distinct vein of manganese ore could be found. The chert is veined with albite. Glaucophane and a greenish fibrous manganese bearing silicate have been secondarily developed.

A short distance west of this massive green chert and on the north slope of the hill, pieces of red chert and a few lumps and small fragments of low-grade manganese ore are found. However, none is in place and the amount of float of manganese ore is small. On account of the depth of the soil and the lack of development work, no estimate of the possible tonnage could be made, but from the surface indications the prospects for a vein of any size are poor. About 120 yards east of the above described massive chert is another outcrop of massive green chert stained with manganese oxide. The amount of manganese is so small in this massive chert that it cannot be considered as a possible source of manganese.

No. 43. Rose Mine. (By Ivan F. Wilson, June 6, 1942.) The Rose mine is 2.5 miles by poor road north of Longvale in sec. 21, T. 20 N., R. 14 W. The mine is on a ridge trending south, on property owned by Dr. J. B. Keaster and D. C. Rose of Longvale. No work has been done since 1918.

Development consists of an open cut 50 feet long driven into the hill toward the north, and a few smaller pits located to the north and west. The bottom of the cut is filled with debris and the ore body is not exposed. On both walls of the cuts are well-bedded red chert with shale partings. The chert on the east wall (footwall) is stained with black manganese oxides. It has a peculiar nodular shiny brown surface coated with manganese oxide. On the west wall of the cut, well-bedded red chert is exposed, and is seen to be underlain in one place by a massive bed of manganiferous chert 2 feet thick, exposed for a length of 6 feet. This bed probably contains 15 to 20 percent manganese. The chert strikes N. 10° E., and dips 40° to 45° W. The chert is offset at the north end of the cut by a fault, striking northwest. A small amount of sandstone is north of the fault. The chert is sharply folded adjacent to the fault, and the north side appears to be the up-thrown side. The small pits northwest of the main cut expose red chert, in part manganese stained, though no ore body is present. A few tons of siliceous ore is piled on the dump beside the open cut. Very little material on the dump appears to contain more than 45 percent manganese. In 1918 thirty tons of ore was shipped which averaged 45 percent manganese and 16 percent silica.

No. 44. Rowlison Prospect. (By Ivan F. Wilson, July 1, 1942.) The Rowlison prospect is 3 miles by road south of Farley Station on the Northwestern Pacific Railroad, in T. 20 N., R. 13 W., on land owned by J. S. Rowlison of Blocksburg. A body of black oxide ore is exposed for a width of 3.5 feet, length of 5 feet, and depth of 3 feet. The ore is in part finely crystalline, probably pyrolusite, but also includes psilomelane. Part appears to be very high grade, but part consists of pink chert. The grade probably is 40 to 45 percent manganese.

The slope on which the block of ore is located has the general hummocky appearance of landslide topography. The ore is on a southeast-trending ridge which projects above the general level of the surrounding slope. Just above the ore to the north is thin-bedded red chert with shale partings. This exposure is 30 feet wide along which the bedding of the chert is fairly continuous, striking N. 80° W., and dipping 30° to 40° N. North of the chert outcrop, fragments of schist were seen.

Another small block of manganese ore occurs 50 feet east of the main block, with no exposures between. A fragment of greenstone occurs 100 feet east, evidently in the landslide. If the blocks of manganese ore are solid bedrock, they may represent a bed trending east parallel to the overlying chert.

No. 45. Salinger Prospect. (By Max D. Crittenden, Jr., August 13, 1942.) The Salinger prospect is located on property owned by J. M. Salinger of Hopland, in sec. 13, T. 13 N., R. 11 W., 5 miles east of Hopland on the road to Lakeport. A 30-foot trench on top of a ridge exposes thin-bedded folded red chert striking N. 70° E., with variable dips. A bed of manganiferous chert 1 foot thick yielded ore that might contain 20 to 35 percent manganese, but the average of the bed is not over 15 to 20 percent. The silica is very high throughout. No ore of shipping grade is in sight.

No. 46. Scott Claim. (By F. S. Hudson and N. L. Taliaferro, October 16, 1917.) The Scott claim is in the NE¼NE¼ sec. 10, T. 18 N., R. 12 W. The location was made on government land by Mrs. C. H. Scott. The working places lie at 2,950 feet above the sea, near the top of the Foster Mountain Ridge. At the most favorable locality, a pit uncovers a north striking vertical contact between a massive jasper bed on the east, and a thin-bedded chert and shale on the west. Along the contact is a 1- to 4-inch leader of clayey manganese oxide. Less than 1 ton of ore is exposed here but apparently it would be worthwhile to follow the leader of oxide ore, as a more extensive body might be encountered.

No. 47. Shaw and Matthews Mine. (By Frank S. Simons, May 1942.) The Shaw and Matthews mine is on property now owned by F. M. Cooper of Santa Rosa in sec. 33, T. 12 N., R. 11 W. The land is leased for sheep raising by Louis McPherson of Healdsburg and J. C. Martin of Geyserville. It is 2 miles by trail, and 3 miles by road from Cloverdale on the Northwestern Pacific Railroad.

No work has been done on this property since 1918. No ore is exposed in the open cut, which is considerably caved. About 2 tons of ore is on the west dump, averaging about 30 percent manganese, and 5 tons on the east dump averaging 20 percent manganese. The best ore seen was a small amount of psilomelane containing probably 40 to 45 percent manganese. Fifty feet south of the main cut is an inclined shaft 10 feet deep, entirely in red chert. A few hundred pounds of ore containing about 30 percent manganese is piled nearby. The mine produced 2 carloads of ore in 1918, averaging 47 percent manganese and 12 percent silica.

No. 48. Shell Rock Deposits. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 46, 1918.) The Noble Electric Steel Company is developing the Shell Rock prospect 6 miles by road west of Spy Rock station on the Northwestern Pacific Railroad in T. 23 N., R. 15 W. The manganese occurs in lenses interbedded in jasper whose outcrop forms a bluff about 500 feet in length and 50 feet high.

No. 49. Skaggs Spring Deposit. (From files U. S. Geological Survey, 1918.) The Skaggs Springs deposit is reported to have produced 457 tons of ore during World War I. The location of this property could not be found during the investigations of manganese in California in 1942. The deposit perhaps may be in Sonoma County.

No. 50. South Thomas Mine. (By Ivan F. Wilson, June 29, 1942.) The South Thomas mine is half a mile south of the Thomas mine (Mendocino 55) in the NE¼ sec. 27, T. 17 N., R. 12 W. It is on the east side of the ridge between Redwood Valley and Potter Valley, at an elevation of 1,500 feet, near the foot of the southeast slope of an oval shaped mountain known locally as Round Mountain. Round Mountain, elongated roughly toward the north, lies between the South Thomas and the

Thomas mine 4 miles by road from Redwood Valley on the Northwestern Pacific Railroad. The last 2.5 miles are now impassable, but could be repaired fairly easily. The mine lies in part on property owned by W. P. Thomas and J. R. Thomas of Ukiah, and in part on property owned by W. H. Travers.

The ore at the South Thomas mine is near the top and toward the south end of the same body of chert in which the Thomas ore body is found. The most of this body is well-bedded red chert with thin shale partings, but some beds of massive white chert are also present. At the South Thomas mine the chert has a strike of N. 10°-15° W., and a dip of 60° to 65° E. The chert swings around rather abruptly to the west, just south of the mine, and the entire chert body, which farther north has an outcrop width of about 1,000 feet, is terminated near the canyon which borders the west and south side of Round Mountain. The rocks to the south are mainly sandstone, some of which is silicified and partly metamorphosed. The contact with the chert here appears to be normal for the chert swings around and strikes N. 15°-50° E. parallel to the contact. Toward the west the chert strikes directly into a belt of metamorphic rocks, including actinolite schist, hornfels, a small amount of serpentine, a rock resembling hornblende gabbro or diorite, and a large area of sandstone. This relationship suggests a fault, and it is thought that the west contact of the chert along Round Mountain is a fault for at least part of the distance, because the contact strikes north, whereas the chert adjacent to the contact strikes N. 35°-50° E. The swing in strike along the south end of Round Mountain is possibly due to drag along this fault. The chert adjacent to the contact to the west is strongly drag-folded, brecciated, sheared, and cut by small faults. Along the trail approaching the mine from the south, sandstone was found, bordered by greenstone on the east. The relationship of this standstone-greenstone contact to the main chert body was not ascertained.

The South Thomas mine contains two parallel beds of manganese ore, separated by about 15 feet of well-bedded red chert. The lower bed to the west is developed by shallow cuts and two adits, one about 25 feet long, and the other started 10 feet higher in elevation and 20 feet farther north along the same bed 10 feet long. The higher bed to the east is developed by an open cut 150 feet long. This higher ore bed is not now exposed. The bottom of the cut is caved, the east wall is not exposed, and the west wall (footwall) reveals red chert with thin shale partings.

The lower ore bed is well exposed in two adits and in open cuts. The thickness varies from 1 foot to 2 feet, and the ore is not of uniform value. Lenses and pockets of rather high-grade oxide ore are found, but much of the ore contains important amounts of white chert in cores and patches. The whole bed probably averages 35 percent manganese, although better grade material could be obtained by sorting.

The lower ore bed is highly sheared, and is cut by numerous fractures filled with zones of black gouge ranging from a fraction of an inch to 2 inches in thickness. The bed has a seam of gouge at the top 3 to 6 inches in thickness. In the lower adit this gouge parallels the bedding of the manganese bed and enclosing chert; it strikes N. 10° W., and dips 60° E. for most of the length of the tunnel. At the end of the adit the gouge zone flattens out and swings over the top of the ore body, cutting it off. It is apparently caused by a bedding fault which deviates and cuts across the bedding at this point, the dip of the fault plane decreasing from 60° to 35° E. At the end of the upper adit is a fault which has a strike of N. 60° E., and a dip close to vertical. The displacement could not be determined.

The lower ore bed is underlain and overlain by well-bedded red chert with thin shale partings. Some of the surfaces and fractures in the chert are filled with porous botryoidal material, consisting in part of black manganese oxide and red iron oxide. This material ranges in thickness from a fraction of an inch to 4 or 5 inches. About 200 feet north of the principal cut at the South Thomas mine, is a T-shaped open cut, the main part running N. 30° W. for 50 feet, and a branch running out to the northeast. On the southwest face is exposed bedded red chert, which is highly broken and slumped by hill creep. Some of it exhibits porous botryoidal surfaces containing black manganese oxides and red iron oxide. The bottom of the cut is caved and no ore is now exposed. Several blocks of siliceous ore were seen in the dump. Most of this probably does not run over 30 percent manganese. A few small specimens of high-grade black oxide ore were seen. Pieces of hard blue-black psilomelane float were observed in the creek between this T-shaped cut and the main cuts previously described. Two small cuts were made northwest of the T-shaped cut, but these exhibit red chert.

According to J. R. Thomas, about 1,500 tons of black oxide ore was shipped from this mine. Most of it was probably obtained from the upper ore bed, which is not now exposed. Nothing can be said as to the future possibilities of this bed, but the total size would probably not be great as compared with the Thomas mine.

About 1,000 feet west of the cuts at the South Thomas mine, in the canyon southwest of Round Mountain, an open cut about 30 feet long exposes rather siliceous manganese ore. The ore body is 1 foot to 3 feet wide, but is spotty and variable in quality. Some of it reveals brown neoticite on fresh exposure, cut by tiny veinlets of rhodochrosite, the whole partly altered to black oxide. The ore occurs in a massive brecciated white chert which appears to be along a shear zone or fault. Bedded white chert to the east strikes N. 50° E., and dips 60° S. The chert in the vicinity is strongly drag-folded, brecciated, and offset by small faults. This locality is near the west contact of the chert along Round Mountain.

No. 51. Spy Rock (Guthrie) Prospect. (By E. F. Davis and A. O. Woodford, August 31, 1918.) The Spy Rock prospect is on land owned by Jim Ray in T. 23 N., R. 15 W. It is on the trail from Spy Rock to Cummings, 5 miles west of Spy Rock Station on the Northwestern Pacific Railroad, and 6 miles east of Cummings. If an old road were repaired, it would be possible to drive by wagon to the prospect. The prospect is held by Alex Guthrie and G. S. Simmerley under a lease from Ray. In 1942 it was leased to the George W. Reed Company of San Francisco. The Noble Electric Steel Company operated the prospect in 1916 and 1917 and removed 20 tons of ore which was never shipped.

A lens of massive chert 15 feet thick is exposed by an open cut 30 feet long. The massive chert is overlain by thin-bedded radiolarian chert. The lower contact is not exposed, but from the nearby outcrops it is probable that the ore body rests on sandstone. The massive chert is granular in texture and is yellow to red in color. It is stained with manganese oxide and here and there contains small irregular lenses of siliceous ore. The best ore is black and shows, on examination with a hand lens, numerous grains of a steel-gray mineral embedded in a siliceous matrix. Remnants of brown ore representing the primary mineral of the deposit are found in a few blocks. The ore varies greatly in its character; streaks, bands, and blotches of very siliceous ore cut through what would otherwise be commercial ore. An average sample of the 20 tons of ore piled on this property assayed 33.4 percent manganese and 34.7 silica.

No. 52. Star Claim. (By N. L. Taliaferro, October 29, 1917.) The Star claim probably is in sec. 25, T. 24 N., R. 11 W., 2.5 miles northeast of Blands Cove and half a mile N. 15° E. of the camping ground known as the Devil's Den. The locators are M. G. Morrison, W. H. Foster, and C. V. Brereton of Covelo. On the steep southwest sloping hillside above the trail from Devil's Den to Howard Crossing much float of manganese stained chert and some low-grade high siliceous manganese ore is found. The blocks of manganese bearing chert generally have a shell of hard grayish psilomelane one-sixteenth to one-half inch thick, and irregular veinlets and cracks stained with manganese traverse the interior of these blocks. Float of a brown manganese carbonate very similar to that on D. D. McLaughlin's claims (Mendocino 35) was found but bedrock was not encountered. This brown carbonate consists of a mixture of rhodochrosite and a yellow or brown resinous manganese-bearing opal. The manganese carbonate dissolves with effervescense in HCl and the manganese is readily leached from the opal, leaving a silica residue which under the microscope is seen to have a very low double refraction and to be below 1.450 in refractive index.

The nearest approach to ore in place was a somewhat peculiarly banded manganese stained chert layer 5 feet thick. This bed strikes east and dips 35° N.; the chert is made up of irregular layers and lenses of the brown manganese-bearing opal, mixed carbonate and manganese-bearing opal, more or less pure manganese carbonate, and chalcedonic silica containing numerous small rhombs and irregular patches of manganese carbonate. These lenses are usually small and irregular, the largest being less than 2 inches wide. The chalcedonic lenses commonly have sharply defined boundaries, but the carbonate and manganese-bearing opal lenses grade into one another. Brecciation and secondary veining have often distorted the banding. Under the microscope the lenses of manganese carbonate and the yellow to brown opaline (?) material are seen to be banded parallel to the long axis of the lens, the bands being both carbonate and manganese-bearing opal and occasionally chalcedony. The chalcedonic lenses have been crystallized to a certain extent and consist largely of fine-grained quartz. In this matrix occur numerous rhombs and aggregates of manganese carbonate. The more perfect rhombs average 0.10 millimeter in diameter. The less perfect rhombs are longer and show spherulitic polarization. Small cubes of pyrite are scattered through this rock. Veinlets of albite, and albite and quartz are also present. The albite and quartz veins are commonly coated with a yellowish-brown to red-brown stain of manganese. Some graphite occurs in the quartz veins.

No commercial ore, with the exception of a few fragments of float of brown carbonate, was seen at this locality, but it is very possible that further prospecting in this vicinity would disclose small beds of good carbonate ore.

No. 53. Summer Camp. (By N. L. Taliaferro, October 14, 1917.) Several prospects are on the Henshaw Ranch in sec. 27, T. 20 N., R. 12

W., west of the road that runs from Hearst to Eden Valley. No development work has been done at this locality. The prospects occur along the strike of a belt of chert which is underlain and overlain by basalt. The general strike is N. 70° E. The contact between the chert and the basalt was not seen, but the basalt is probably intrusive. The general section is: (1) basalt at the base, (2) a few feet of thin-bedded chert and shale, (3) chert carrying iron and manganese oxides and varying in thickness from 7 to 15 feet, and (4) basalt.

At the most northeasterly prospect is an outcrop of red chert, much stained with red iron oxide, and black manganese oxides, with the iron predominating. In places, the chert apparently passes into a siliceous hematite ore carrying a small amount of manganese. Films of manganese are common. The strike is N. 70° E., the dip is 45°-50° SE. The basalt apparently has the same attitude as the chert.

About 150 yards to the southeast is another outcrop, very similar to the above, except that the dip is to the northwest and the ore is underlain by the thin-bedded red chert and shale. Here the iron-manganese bearing chert is 7 or 8 feet wide and has been almost wholly converted to a siliceous hematite ore carrying manganese. The manganese occurs as stains and locally in small veins. A small amount of manganese ore could be obtained here by hand sorting. An average sample is said to contain 10 percent manganese.

Less than a quarter of a mile west-southwest of this locality is another exposure of the iron-manganese bearing chert. Here the section is the same as given above except that a bed of massive green chert several feet thick lies between the ore and the overlying basalt. The dip is to the northwest. The ore is the same as at the two localities described above. The manganese occurs as mirrors of psilomelane and as stains and small veins through the chert and red iron oxide. The ore is somewhat thicker here. This belt of chert stained by red iron oxide and manganese is continuous to the Ocean View locality (Mendocino 40) but no good manganese ore was seen at any point. The tonnage in this belt is large, but the ore is so high in iron and silica and so low in manganese that it is not of great economic importance as an ore of manganese.

No. 54. Thatcher Creek Prospects. (By E. F. Davis and A. O. Woodford, August 22, 1918.) Lige Shields, Charles Packwood, and B. Shields of Covelo, have located a number of claims for manganese near the junction of Jacks Hollow Creek with Thatcher Creek in sec. 23, T. 21 N., R. 11 W., Mt. Diablo base meridian. The claims were leased to Michaels, Roman, and Weeks during the fall of 1917, but were not worked. The deposits are 17 miles by trail from Covelo. In order to reach a railroad it would be necessary to build 9 miles of mountain road to the county road from Covelo to Dos Rios. The total distance from the prospects to Dos Rios would be 22 miles.

The region around the junction of Jacks Hollow Creek with Thatcher Creek contains considerable greenstone of the Franciscan group. It is resistant to weathering and stands up in fairly steep cliffs. On the ridge between Jacks Hollow Creek and Thatcher Creek are bodies of manganiferous iron ore enclosed in the greenstone. The exposed surfaces of the ore are usually heavily coated with black manganese oxide. The cracks and fissures in the ore are similarly coated. As a result, the true nature of the ore is not seen, except on freshly broken fractures. The ore is of several types. One variety is dark red in color with an extremely fine-grained texture and is apparently a compact siliceous hematite ore. A specimen of this ore gave 9.9 percent manganese, 57.6 percent iron, and 27 percent silica. Another variety is red to red-brown, and has a waxy luster and a smooth conchoidal fracture. It is soft and brittle, breaking into numerous little pieces with irregular curving boundaries. It is a mixture of ferric oxide and opaline silica. A third variety is identical to the second save that its color is green and it contains a considerable amount of ferrous iron. A sample of this material yielded 14.4 percent manganese. A few stains of malachite and azurite are seen in the iron ores.

The ore bodies show sharp, clean-cut contacts against the greenstone, but the boundaries are exceedingly irregular and have numerous reentrants. The mode of origin of these iron ores is not certain. The iron ore shows no sign of metamorphism or alteration at the contact with the greenstone so it is not likely that the greenstone has invaded previously existing bodies of iron ore. The opaline character of a large part of the ore is also contrary to the idea that it has been subjected to thermal metamorphism. The greenstone is very fine-grained; it is not vesicular and shows no pillow structure. Though the exposed surfaces are large there is little evidence of layering of successive flows; the greenstone appears to be massive. However, as the greenstone is not intercalated with soft fine-grained green shaly material, it probably, in part at least, is extrusive. The iron-bearing rocks of the area may be contemporaneous chemical sediments.

Several bodies of this sort are in the greenstone and it is probable that at least ten thousand tons of siliceous manganiferous iron ore could be obtained here. No rocks here could be marketed at the present time either as a source of iron or manganese.

No. 55. Thomas (Round Mountain) Mine. (By Ivan F. Wilson and Max D. Crittenden, Jr., June 1942.) The Thomas mine is 15 miles north of Ukiah, in the N½ sec. 22, T. 17 N., R. 12 W. It is on the east side of the ridge between Potter Valley and Redwood Valley and is reached by road extending 4.5 miles northeast from Redwood Valley. The last 3 miles of this road are now impassable, but could be made passable with little difficulty.

The general setting of the mine is shown in plate 3. The main workings are on the east slope of Hill 1750 and on Hill 1810 at an altitude of 1,500 feet. The maximum relief of the surface traversed by the ore body is 320 feet. Two trails or sled roads lead from the lower workings to a loading point in the saddle west of Hill 1750. The mine is owned by W. P. Thomas and J. R. Thomas of Ukiah.

The ore body is near the top of a chert bed that ranges in thickness from 75 to 500 feet and averages 450 feet. The chert body includes well-bedded red chert with thin shale partings, and white, buff to yellow chert. Some of the white chert is more massive than the red, although in places it is thin-bedded. On the south slope of Hill 1750 are two distinct belts of white chert, surrounded by red chert. The white and red chert appear to interfinger. At least one of the white chert belts continues southeast to Hill 1810, but the north slope of this hill is too poorly exposed to make mapping of the two types of chert feasible.

The chert is underlain (assuming that the main chert belt is not overturned) by sandstone, which extends beyond the area mapped. This sandstone is the typical green to brown arkosic sandstone of the Franciscan, interbedded with siltstone, sandy shale, and dark-colored clay shale. Conglomerate is interbedded with the sandstone in a few places. The pebbles have a maximum diameter of 4 inches and are well-rounded. They are chiefly black chert, quartzite, and porphyry. One pebble of aplitic granite was seen. The rocks along the road from Redwood Valley are also chiefly sandstone, with some areas of greenstone, and a few loose blocks of glaucophane schist.

A narrow belt of sandstone 25 to 80 feet thick also overlies the chert. The character of the rocks in this belt, which is poorly exposed, is similar to that listed above, except that no conglomerate was seen. Overlying this thin belt of sandstone is a large mass of greenstone which extends northeast apparently for a considerable distance beyond the area mapped. Although the greenstone is generally highly altered, a few specimens were observed with rather fresh lath shaped plagioclase phenocrysts exhibiting albite twinning. Some specimens are fairly coarse grained, exhibiting both plagioclase and augite. Some of the greenstone is amygdaloidal, the amygdules in general being filled with calcite and occasionally with a green chloritic material. In addition to the main belt of greenstone overlying the chert and sandstone, smaller masses occur within the chert and within the sandstone.

The rocks described above are in parallel belts trending N. 45° W., with a general dip to the northeast. The strike of the chert is dominantly N. 45° W., but ranges from N. 10° W. to N. 60° W. The dip in general is northeast at angles of 45° to 80°, although in places it is vertical, and on Ridge 1850 it is southwest. Drag folds occur in the chert in places, especially near the base of the chert in the canyon between Hills 1750 and 1810. The entire sequence of sandstone, chert, sandstone, and greenstone is displaced between Hill 1750 and Ridge 1850 by an east-west transverse fault. The apparent horizontal displacement is about 200 feet, the north side having been shifted relatively toward the west.

The manganese ore occurs near the top of the chert body. The main ore body is on the east slope of Hill 1750, continuing across the canyon to the south to the north slope of Hill 1810. This belt has a length of 650 feet, judging from the position of the old workings. A smaller belt occurs north of the transverse fault mentioned above, on the south slope of the ridge. This belt was explored for a length of 120 feet. It may be the same bed stratigraphically as the main ore body, but the two are not now connected.

The main ore body on Hill 1750 has a general strike of N. 45° W., and a dip ranging from 65° NE. to nearly vertical. Across the canyon to the south the strike changes to N. 10° W., and the dip ranges from steeply east to vertical. The small ore body on Ridge 1850 has a strike of N. 20°-30° W., and a steep dip to the west.

The main ore body is cut by small transverse faults. A few of these exposed in an open cut on Hill 1750 have a general strike of N. 60°-65° E., and a steep dip to the southeast. The north sides of the faults are displaced to the west with respect to the south sides. If the movement were vertical, the north sides of the faults would be downthrown and the faults would be reverse faults. At the end of the lowest adit on Hill 1750 is a fault striking north, and dipping 35° E. A fault in the lower adit on Hill 1810 strikes N. 20° E., and dips 70° SE. The displacement of these faults could not be determined.

In a cut on Hill 1750 and again in the adit on Hill 1810 the ore body was bordered on the top (to the east) by strike faults, producing in each case a zone of gouge 2 to 3 feet thick. In the cut on Hill 1750 this fault, or a branch fault, apparently flattens out and swings across the top of the ore body cutting it off from the surface. At this point the ore body is below the fault, and red chert is above it.

The manganese ore apparently was underlain throughout by well-bedded red chert. The lower part of the ore body was evidently more siliceous than the rest, and in many places was not mined. On the geologic map (pl. 3) the boundary of this siliceous ore with the chert, wherever exposed, is shown as the lower contact of the manganese ore. The rest of the ore body is mapped on the basis of the presence of cuts or stopes, since for the most part the ore is not now visible and most of the workings are caved. The upper contact of the ore body is not as well exposed as the lower, but in two or three places the overlying rock was seen to be well-bedded red chert, or the gouge zone previously mentioned.

The siliceous ore, which in places was left at the bottom of the ore body, contains black manganese oxides with large quantities of pink and white chert in cores and patches. Some of it shows finely banded red, pink, and white chert and black oxides. In places soft black oxides are laminated with thin red shale, the whole occurring in the manner of shale partings of the normal chert. This material probably averages 20 to 30 percent manganese, but a better grade might be obtained by sorting. About 10 feet of this type of ore is exposed along the base of the ore zone in various places.

No high-grade black oxide ore is now exposed. A few specimens of high-grade ore were seen on some of the dumps. About 10 tons of ore are piled on a dump just above the canyon on the north slope of Hill 1810. Much of this is what has been called "brown ore." It is apparently neotocite, with a thin coating of black oxide which has developed since the material has been on the dump. The fresh material is dark brown, has a vitreous to resinous luster, conchoidal fracture, and hardness of about 4. The texture varies from fine-grained, dense, to coarse-grained, granular. The ore body is cut by veinlets of pink to white rhodochrosite, ranging in thickness from microscopic dimensions to an eighth of an inch.

Most of the ore was mined from a long open cut along the east slope of Hill 1750. The main cut extends for a distance of 350 feet; another cut 50 feet north extends for 80 feet; a cut south of the canyon on the north slope of Hill 1810 extends for 100 feet; and cuts on Ridge 1850 extend for 120 feet.

Three adits were driven northwest along the ore body on Hill 1750, at elevations of 1,530, 1,560, and 1,570 feet. The middle one of these is caved and the others partly caved. Farther north two adits were driven southwest into the hill. Both adits are caved. One is 150 feet northeast of the ore bed at an altitude of 1,630 feet; the other is 100 feet farther west at an altitude of 1,670 feet. The dump of the easternmost tunnel reveals greenstone, sandstone, and chert; and it is thought that these rocks were mined in that order. Another caved adit occurs near the bottom of the canyon 170 feet northeast of the ore bed at an elevation of 1,460 feet. The dump reveals greenstone and sandstone. This adit probably did not reach the chert bed.

South of the canyon on the north slope of Hill 1810, an adit was driven south along the ore body at an altitude of 1,550 feet; two others, now caved, were driven southwest at an altitude of 1,590 and 1,620 feet. The highest of these has greenstone fragments on the dump, and it is not certain that this adit struck the ore body. A lower adit may have been driven at about the creek level on this slope, but if so it is completely caved. Several small trenches and pits were dug at various places in the area, and these are indicated on plate 3.

The Thomas mine is reported to have produced 6,230 tons of ore from 1914 to 1918, averaging 50 percent manganese, and 7 to 10 percent silica. Of this amount 1,500 tons may have come from the South Thomas mine. Because of its relatively large size and high grade compared with other California deposits, this mine deserves serious consideration. It is probable that most of the high-grade black oxide ore has been mined. One favorable place for obtaining a small amount of ore would be the bottom of the canyon between Hill 1750 and Hill 1810, where no development has been done and which is now covered with dump. J. R. Thomas states that the ore cropped out here before being covered, and it probably continues across the canyon since it was found on both sides.

Another possibility is on the north slope of Hill 1750, between the northernmost open cut and the transverse fault which offsets the chert. The ore body, if projected between these two points, would have a length of 200 feet. This area has been incompletely explored. It cannot be determined from the surface whether the ore body extends across this area, because the ground here has a deep covering of regolith. Other possibilities would be extensions beyond the northernmost workings on Ridge 1850 and beyond the southernmost workings on Hill 1810. No favorable ore beds crop out in either of these areas. Siliceous ore is exposed in a few places along the footwall of the ore body, as mentioned before.

The greatest possibilities of this mine at present would seem to be in the primary ore. This is apparently largely neotocite on Hill 1810. The nature of the primary ore on Hill 1750 is uncertain, but it has been suggested that it is chiefly rhodochrosite. If either of the types of ore can be utilized, the possibilities for large reserves are good. Exploration by diamond drilling or other methods would seem advisable to determine the size of those reserves.

No. 56. Two Trees Prospect. (By N. L. Taliaferro, October 28, 1917.) The Two Trees prospect is 1.3 miles east of North Fork of Middle Fork of Eel River and well up on the ridge. It is between Howard and Fly Creeks probably in the NW ¼ sec. 32, T. 24 N., R. 10 W. The locators are J. D. Morrison and George H. Brereton of Covelo. No development work has been done. This prospect is in an area where slides have been numerous. The area contains many small undrained depressions, some of which are fairly deep.

The ore is not found in place and is apparently float from a large slide block. About 15 tons occurs as float within a radius of 100 feet. The ore is of fair quality and consists of psilomelane, pyrolusite, and brown carbonate. The smaller fragments are completely oxidized and consist of the black oxides with residual yellowish, porous, spherules of silica. Blocks of manganiferous chert containing numerous spherules of manganese carbonate and shells of oxide ore are also fairly common.

About 20 feet from the discovery stake is a large block of pink chert containing a layer of manganese ore parallel to the bedding. The layer, as shown in this float block, is 30 inches wide. The surface of the ore has been oxidized, but when broken the original material is seen to be a dense dark brown carbonate. Thin veinlets of pale pink, finely crystalline rhodochrosite are present. This brown ore is an intimate mixture of manganese carbonate and the brown, manganese-bearing opal. It is very similar in appearance to the brown carbonate found on D. D. McLaughlin's claims (Mendocino 35).

No. 57. Ukiah Prospect. (From files U. S. Geological Survey, 1918.) A deposit near Ukiah is listed in the files of the U. S. Geological Survey for 1918. The location of the deposit is unknown.

No. 58. Usal Deposits. (By Parker D. Trask and Doak C. Cox, September 1941.) The Usal manganese deposits are in northwest Mendocino County at altitudes ranging between 800 and 1,700 feet near the crest of the divide between Usal Creek and the South Fork of the Eel River. They are distributed over an elliptical area about 3 miles long and 1 mile wide in secs. 1 and 2, T. 23 N., R. 18 W., and secs. 26, 35, and 36, T. 24 N., R. 18 W. They are reached by trail, 4 miles in length from Usal. Usal is 35 miles by road from Fort Bragg, the nearest rail point. This road for 5 miles south of Usal is poor and has steep grades. The remainder is paved. The steep 1,000-foot climb out of Usal could be avoided by bulldozing a road along an old wagon road that is now washed out and overgrown with brush, and which extends for 4 miles along the crest of the ridge between the south end of the manganese deposits and the highway from Route 101 to Westport. If ore is ever transported on this route, it could be taken to Longvale, on the Northwestern Pacific Railroad, a distance of 45 miles. The deposits are mainly on land owned by the Sage Land & Development Company, and by the Crocker National Bank, both of San Francisco. No development work has been done, but the Sage Land & Development Company in 1940 collected several samples and had them assayed. The results are given in the table below.

Table 3. Analyses of ore from the Usal deposits, Mendocino County, California.

Location	Manganese	Iron	Acid insoluble	Aluminum and lime	Ignition loss	Iron and manganese combined	Silica	Silica and insoluble	Lime	Magnesia	Phosphorus	Sulfur
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Iron gulch	15.03	37.10	16.51	5.03	8.30	53.61	-------	-------	-------	-------	-------	-------
Iron gulch	15.48	35.22	15.54	4.24	12.03	50.70	-------	-------	-------	-------	-------	-------
Iron gulch	23.24	32.45	16.52	5.83	8.99	55.69	-------	-------	-------	-------	-------	-------
Iron gulch	22.81	32.59	16.21	4.51	9.03	55.40	-------	-------	-------	-------	-------	-------
General sample	8.42	27.70	-------	-------	17.74	-------	13.40	-------	8.60	1.08	0.210	.04
Dugan opening	17.20	34.04	-------	-------	-------	-------	-------	14.76	3.64	5.54	0.58	0.16
General sample	7.22	35.72	-------	-------	-------	-------	10.48	-------	-------	-------	-------	-------
	8.13	30.34	-------	-------	-------	-------	16.42	-------	-------	-------	-------	-------
	1.79	33.80	-------	-------	-------	-------	10.26	-------	-------	-------	-------	-------
	0.00	5.26	-------	-------	-------	-------	66.54	-------	-------	-------	-------	-------

First four samples analyzed by H. O. Seifert Laboratory; remainder by Smith, Emery & Company.

The ore is manganiferous iron oxide, which replaces limestone. It is found in a series of feldspathic sandstone and greenstone zones, presumably of Franciscan age. The prevailing strike is northwest and the dip 50° to 70° E. The greenstone consists of flows, tuffs, and intrusive rocks of approximately andesitic composition. The limestone is found in scattered small lenses, most of which are less than 5 feet thick and 20 feet long. The largest limestone body is 50 feet thick and 150 feet long, and is located in the middle of Dugan's opening. The base of the limestone at this place is intruded by greenstone, and the limestone for 3 feet above the contact is replaced by manganiferous iron ore. The replacement becomes progressively less for the next 4 feet, but beyond 7 feet from the contact the only evidence of replacement are a few flecks of specular hematite and a pinkish color.

The normal limestone is a light gray, fine-grained deposit, whose origin in some way seems connected with the greenstone, for most of the deposits rest upon greenstone, though some are beneath greenstone and some within it. The thick soil and underbrush obscures the stratigraphic and structural relations of the deposits, but faults are present, particularly on the north side of the large limestone body in Dugan's opening.

About 30 lenses of limestone were found, mainly in two northwest-trending belts from 300 to 1,000 yards apart. Most of the lenses were mineralized, but only a few of them contained more than 5 tons of ore. The largest ore body is the one in Dugan's opening.

The ore is a manganiferous iron ore, presumably an oxide. It is dense and opaque, and difficut to identify by ordinary field or microscopic methods. The manganese content ranges mainly between 10 and 25 percent, and iron between 25 and 35 percent. The silica content is low, 10 to 15 percent. The ore is dense and splintery, and in some ways it resembles braunite. The content of silica in the ore suggests braunite.

No. 59. Wild Devil Mine. (By Ivan F. Wilson, June 30, 1942.) The Wild Devil mine is near the north line of sec. 15, T. 17 N., R. 12 W. It is west of the summit of the long ridge between Redwood Valley and Potter Valley, at an altitude of about 2,000 feet. It is 2 miles by road north of the Thomas mine (Mendocino 55). The total distance by road from Redwood Valley on the Northwestern Pacific Railroad is 6.5 miles, of which the last 5 miles is now impassable but could be repaired without great difficulty. The mine is on the crest of a small ridge trending west from the main summit ridge. A landslide area is south of this transverse ridge, and other large landslides occur in the general vicinity. The mine was said to have been owned by Waldteufel Brothers, George B. Richardson, and others, of Ukiah in 1918, but the present ownership was not determined.

The manganese ore is enclosed in well-bedded red chert with thin shale partings. The chert here has a general strike of N. 60° W., ranging from N. 25° W. to N. 75° W., and a general dip of 50° NE., ranging from 35° to 70°. In detail the chert is highly crumpled, brecciated, and offset by small faults. Toward the top of the cut exposing the ore the chert is broken up into a regolith to a depth of several feet and is covered by hill creep. Southwest of the ore body, a few beds of massive white chert are enclosed in the red chert, and on the northeast wall of the cut, well-bedded white chert is interbedded with red chert. The base of the red chert was not observed, but it extends at least 300 feet southwest of the ore bed. The chert is overlain on the northeast by sandstone, exposed about 150 feet from the ore bed. The chert is terminated on the southeast by a large landslide.

This chert is along the same general line of strike as the chert that encloses the ore at the Thomas and South Thomas mines. However, the bed of chert is not now continuously exposed. It is covered in places by landslides, and in other places it is offset by faults.

The manganese ore has been developed along a cut 180 feet long, with a depth of 10 to 20 feet, and average width of 10 feet. The cut varies in direction from N. 25° to 50° W. The bottom of the cut is caved and the ore is now exposed only in small pockets. The ore body is said to have a maximum width of 6 feet. An adit, now caved, was located down the hill to the southwest about 100 feet from the cut. The dump reveals red chert and no ore.

Well-bedded red chert is exposed on both sides of the cut. White chert is found in the northeast wall (hanging wall). The ore body apparently is offset by numerous small faults. A few pockets of high-grade ore still remain. Some of these are 2 to 3 feet thick, but most of them are less than 1 foot thick. A few specimens were seen with cores of neotocite which is brown and resinous, with conchoidal fracture. The neotocite is cut by tiny veinlets of white rhodochrosite, and the whole mass is surrounded by thick shells of black oxides. Past production is reported as 250 tons.

No. 60. Wishbone Deposit. (By Ivan F. Wilson, June 6, 1942.) The Wishbone deposit is in T. 20 N., R. 14 W., about 2 miles north of the Rose mine (Mendocino 43), on a slope 0.2 mile south of Cherry Creek, at a place called "The Retreat." This prospect is reached by a road turning off to the east 3 miles north of Longvale, and is 3 miles along this road. It is on the property of Dr. J. B. Keaster and D. C. Rose.

On this prospect is rather siliceous ore enclosed in well-bedded red chert with shale partings. The chert strikes northwest and dips northeast, but is locally faulted. At one point a tunnel driven into the hill to the south for 15 feet crosses a body of siliceous ore 2 feet thick. The surrounding red chert is complexly faulted. The ore bed here extends east 30 feet. It is chiefly white chert, penetrated by manganese oxides (pyrolusite and psilomelane), and probably contains 10 to 20 percent manganese.

A large area of chert lies near the mouth of Cherry Creek, near the old station of Carbon on the Northwestern Pacific Railroad, 5 miles northeast of Longvale Station. Here, for a distance of at least half a mile from the mouth of the creek, are remarkable exposures of chert in bold outcrops, forming steep cliffs on the north side of the creek. The chert is extremely contorted, dragfolded, and faulted. The chert is mainly well-bedded red chert with shale partings, but to some extent is thick-bedded and massive white chert, and to a less extent, thin-bedded green chert.

Much of the red chert is manganese-stained, and contains a few thin beds, 0.5 to 1 inch thick, of manganese oxides. Some beds of white chert are penetrated by considerable quantities of manganese oxide, other beds probably containing 10 percent manganese. A few pieces of float of fairly highgrade black oxide ore (possible 40 to 45 percent manganese) were found. Only one bed of the rich ore was seen, in the bottom of Cherry Creek about half a mile from its mouth. The bed is 1 foot to 2 feet thick, and is exposed for 6 feet. It is overlain by red chert, and crops out in an erosional window in the chert. It is chiefly hard psilomelane ore, containing chert and estimated to have 40 to 45 percent manganese. No development has been done. This area deserves prospecting because such a large mass of chert is present and float of good manganese ore is found in the vicinity.

No. 61. The Young Mine. (By E. F. Davis and A. O. Woodford, August 13, 1918.) The Young mine is owned by E. M. Young of Willits, and was operated under lease by James E. Page of Willits, but the lease has now expired. It lies in sec. 28, T. 19 N., R. 13 W., in the hills on the south side of String Valley. The mine is 0.2 mile from a wagon road, and it was planned to haul the ore this distance on sleds. From the loading point it is 7 miles to Willits.

The ore bodies are enclosed in thin-bedded red radiolarian chert which strikes east. The dip varies between 55° and 70° S. Three working places were developed but no ore was shipped. At two of these the ore is found in place, whereas at the third no solid rock is exposed and the ore is found as loose blocks embedded in the soil. At the east working an open cut has exposed an ore zone 10 feet wide. The lower 8 feet of the ore zone is massive, but the upper 2 feet consists of thin beds of bright red shale alternating with thin beds of high-grade black psilomelane. Occasionally lenticular beds of red chert or a nodule of red chert lie within the ore zone. The beds of ore are all lens-like, having a thickness of half an inch and a length of 6 inches to 1 foot. A few flattened ellipsoidal button-shaped nodules of manganese ore have their longer axes parallel to the general bedding.

The massive ore in the lower part of the zone is a hard black siliceous ore containing lenticular bands of red or pink chert. These bands have a thickness of 0.2 to 0.4 inch and are from 2 to 6 inches long. In parts of the ore body these lenses of chert become so closely spaced that they give a striped appearance. Everywhere the long axes of the lenses of chert lie parallel to the bedding of the radiolarian chert that encloses the ore body. The small lenses of chert thus included in the massive black ore were found to contain many radiolaria. The chert that encloses the ore zone is heavily stained with manganese oxide along fracture cracks.

The ore zone is 10 feet wide and is exposed for a length of 30 feet. It crops out locally for 15 feet along the dip. A general sample of the ore in this body gave 24.6 percent manganese and 57.5 percent silica. A sample of the siliceous ore with bands of red chert was hand picked to remove as much of the silica as possible. It assayed 41.1 percent manganese and 33.4 percent silica. A few localized bodies within the massive ore are rich in manganese. One sample of such material assayed 54.3 percent manganese, 12.7 percent silica, and 10.3 percent available oxygen. The amount of such ore is small. About 10 tons of this material has been removed. Forty tons of siliceous ore is piled on the ground at this working place.

Two hundred feet west of the main working a series of open cuts exposes a large number of loose boulders of ore embedded in the soil. These lie down hill from the line of the ore zone exposed in the other two workings and the blocks are probably derived from the ore zone. At this place are 20 tons of ore running about 40 percent manganese and 25 percent silica.

About 350 feet west of the first working and apparently on the same horizon of ore, an open cut exposes a body of banded ore enclosed in thin-bedded red radiolarian chert and shale. The ore body is 3 feet wide and consists of high-grade blue-gray psilomelane in lenses separated by red chert and red shale. The lens-like layers of chert and ore are 0.5 to 1 inch thick and may have a length of 1 foot. Usually they are half an inch thick and 4 to 6 inches long.

The lenses of ore are high grade and rather tough. The intervening chert lenses are very brittle and it would be possible to separate ore and chert without difficulty. Ore of this banded variety might be hand picked and would yield readily to mechanical concentration. Ten tons of this banded ore has been removed. The ore contains 35 percent manganese and a like amount of silica.

MERCED COUNTY

No. 1. Briggs Mine. (By Max D. Crittenden, Jr., September 26, 1942.) The Briggs mine is just within the border of Merced County in the S½NW¼ sec. 13, T. 13 S., R. 9 E. It is reached by 30 miles of poor road, via the McCreery and Frandsen Ranches, in the old Cleveland district. The road ends 1 mile from, and about 2,000 feet below, the prospect. The property is owned by Mrs. Briggs of Hollister. Development consists of several small pits and trenches. The Briggs prospect is near the upper contact of a band of chert 100 feet thick, surrounded by sandstone. The main mass of the chert forms rugged outcrops and cliffs above the sandstone, but the chert in which the manganese is found is above the steepest part of the hill.

The general strike of the beds in this area appears to be N. 60° E., the dip is gentle to the north. The beds are cut by several faults with moderate throws. Small folds and faults are common. The primary ore consists of manganiferous chert beds, from which extensive surface oxidation has produced small quantities of good grade oxide ore, but which contain much silica.

MONO COUNTY

No. 1. Black Horse Claim. (By Ivan F. Wilson, October 14, 1942.) The Black Horse claim is in the Sweetwater Mountains 9 miles in an airline north of Bridgeport in the N½ sec. 8, T. 6 N., R. 25 E. It is 3 miles by trail southwest of Monte Cristo (an abandoned gold mine) which is 26 miles by road north of Bridgeport. The claim is located north of the divide between Frying Pan Canyon and Murphy Creek, at an altitude of 9,200 feet, on the steep northeast slope of a peak which forms a 9,500-foot closed contour on the Bridegport quadrangle. The claim was located July 27, 1940, by R. J. Thomas, R. Fredrickson, and Bert Davis. Work has been suspended for the winter, but further work is contemplated.

The main development is a cut 28 feet long, 4 feet wide, and 15 feet deep at the face, with a shaft started at the end which has been dug only 5 feet below the surface of the cut. This cut runs S. 30° E. into the hill. Another cut 30 feet west is caved, and reveals only talus fragments. A tunnel 15 feet in length has been driven S. 50° W. into the hill.

The workings reveal a hard, compact, pyroclastic rock, tentatively identified in the field as a crystal, lithic, andesitic tuff and breccia. The composition may be closer to a dacite. The rock is gray when fresh, weathering reddish brown. It reveals crystals of plagioclase and biotite, perhaps some quartz, and fragments of andesitic rock from a fraction of an inch to an inch long. Some of these lithic fragments are greatly elongated.

The main open cut reveals stringers 1 inch to 3 inches thick of botryoidal psilomelane, stained with iron oxide. There is also a brecciated zone about 1 foot thick in which the rock fragments are cemented with psilomelane. The stringers trend in various directions, although the general strike seems to be more or less northwest, and the dip southwest. In one place the psilomelane is associated with a stringer of red brown opaline jasper 4 inches thick. The psilomelane in the stringers is high grade. One specimen consisted of a steel gray crystalline mineral in thin layers paralleling the botryoidal surface of the psilomelane. The crystals were tabular, possibly orthorhombic. This mineral may be manganite.

The bedrock is covered by a talus accumulation 4 feet thick. The tunnel was driven toward the zone of manganese stringers exposed in the main open cut, but at the time it was visited, the tunnel was still in wall rock.

No. 2. Champion Claim. (By Ivan F. Wilson, October 13, 1942.) The Champion claim is located on Clearwater Creek in sec. 25, T. 4 N., R. 25 E. It is 1.7 miles along the road to Bodie, which leaves Highway 395 at a point 7.5 miles south of Bridgeport. It is on a steep southwest slope 100 yards northeast of the road at an altitude of 7,200 feet. The nearest shipping point is 44 miles northeast at Hawthorn, Nevada, over a graded dirt road. The claim was located by George Moyle of Bodie, June 30, 1942.

Development consists of a small pit. This pit reveals a vein or fissure zone about 1 foot thick, exposed for about 5 feet, containing psilomelane coated with clay and iron oxide. Toward the top is a mixed zone in which psilomelane cements fragments of the overlying andesitic rock. A very little soft, black, sooty manganese oxide is found with the psilomelane. The fissure zone strikes N. 10° W., and dips 60° E. The deposit resembles, on a smaller scale, the Taylor deposit (Mono 6).

The bottom of the pit reveals a block of granitic rock 1 foot thick. This block was determined in the field as biotite-hornblende granodiorite. Its relationships are obscure. It may be a loose block, or a sliver which has been faulted in. Below this granite rock, to the west, is a zone a few feet wide of white tuff or volcanic breccia. The surrounding rocks, which cover a wide area, are porphyritic volcanics, gray when fresh, but red when weathered. A field determination classifies them as andesite porphyry, containing plagioclase phenocrysts 0.1 to 0.2 inch in diameter, and smaller biotite phenocrysts in an aphanitic groundmass. Some float of botryoidal psilomelane fragments occur near the pit, and farther up the slope.

No. 3. Miami Prospect. (From files of U. S. Geological Survey, 1918.) The Miami deposit is in sec. 1, T. 3 N., R. 25 E., 60 miles south of Hudson. It is said to be owned by L. A. Murphy and W. A. McRae of Bridgeport. It is reported to be a fissure deposit from which 25 tons of ore was mined, but none was shipped. A sample assayed 54 percent manganese, 1.5 percent iron, and 1 percent silica.

No. 4. Mono Manganese No. 7 (Wade) Prospect. (By Ivan F. Wilson, October 13, 1942.) The Mono Manganese No. 7 or Wade property is 11 miles south of Bridgeport in sec. 1, T. 3 N., R. 25 E. It is reached by turning east from Highway 395 at a point 4.4 miles north of Conway

Summit and following a dirt road for 2.2 miles. Coming from the north, this road turns off 1.8 miles south of the junction with the Bodie road. The claim is 2 miles north of the Taylor property (Mono 6). It is in a gently sloping area just west of Little Mormon Meadow, at an altitude of 7,600 feet. The manganese workings are west of, and on the opposite side of the road, from an old gold mine known as the Little Bodie mine. The claim was located June 14, 1940, by J. L. Wade of Long Beach.

Development consists of four open cuts. These cuts are in a porphyritic volcanic rock, determined in the field as a hornblende-biotite dacite or andesite. This rock is gray when fresh, but weathers purplish to brownish. It contains phenocrysts 0.1 to 0.2 inch long of lath-shaped plagioclase, hornblende, and biotite, and perhaps some quartz. These are contained in a gray aphanitic groundmass.

The westernmost cuts reveal stringers of high-grade hard black botryoidal psilomelane 1 inch to 3 inches thick. These stringers occur along fractures inclined in various directions. No bodies of psilomelane larger than these stringers were seen. The volcanic rock in the easternmost cut is brecciated. Small fragments of botryoidal psilomelane float are scattered over the surface between and surrounding the various pits.

No. 5. Penrose Prospect. (By Spangler Ricker, 1942.) The Penrose prospect is in T. 7 N., R. 25 E., on Sweetwater Creek near the Nevada border. It is owned by Jack Penrose. The deposit is composed of limonite and wad, and lies in the floor of a valley. The country rock is rhyolite. A sample assayed 5.04 percent manganese.

No. 6. Taylor Property (Moyle Group of Claims). (By Ivan F. Wilson, October 12, 1942.) The Taylor property, also known as the Moyle group, is 2 miles north of Conway Summit, between Bridgeport and Leavining, in the NW¼ sec. 13, T. 3 N., R. 25 E. The prospect is reached by proceeding along Highway 395 north of Conway Summit for 2.2 miles, then turning east over a dirt road for an additional 0.9 mile. The property is 12 miles by road south of Bridgeport. The workings are at an altitude of 8,100 feet, on a gentle south slope near the top of a hill (indicated by a closed 8,200 feet contour on the Bridgeport quadrangle). A sufficient flow of water for a mill is present in Virginia Creek, a permanent stream, located 1 mile west and 500 feet lower in elevation. A road leads from the manganese property to this stream.

The property is leased to, and is being operated by, William Bell Taylor of Mono Lake. It consists of six claims: Manganese No. 1, located December 26, 1939; Manganese Nos. 2, 3, and 4, located December 28, 1939, by George Moyle of Bodie; and Bluebird Nos. 1 and 2, located August 12, 1942, by Mrs. Venita McPherson. The workings are on Manganese No. 1.

Development consists of a series of cuts and shafts distributed over a length of 200 feet. The manganese ore at this property occurs in a brecciated fissure zone in a porphyritic volcanic rock. This brecciated zone is 8 to 11 feet wide, and consists of fragments of porphyritic rock of varying size included in a matrix of manganese oxides (mostly psilomelane), iron oxide, clay, and gouge. In places the rock fragments are 1 foot to 2 feet in diameter; elsewhere they are commonly a fraction of an inch to 2 or 3 inches across. Parts of the fissure zone are made up chiefly of rock fragments, with a small amount of manganese oxide and clay filling the interstices; other parts are composed mostly of manganese oxide and clay, with a few small rock fragments scattered through. The fissure zone in places has fairly sharp boundaries with solid porphyritic volcanic rock on both sides. The zone strikes N. 45°-50° W., and dips 65° NE. It is exposed discontinuously in the cuts over a length of 200 feet. A cross fracture trending northeast is in the southeasternmost cut.

The porphyritic volcanic rock was tentatively determined in the field as a biotite andesite porphyry. It contains plagioclase phenocrysts an eighth to a quarter of an inch long, with smaller phenocrysts of biotite in an aphanitic groundmass. It is gray when fresh, but weathers brownish. Similar rocks cover a large area around the prospect, and in road cuts to the north they are intercalated with volcanic breccias and tuffs. A belt of soft white tuff and breccia lies just south of the manganese prospect, and seems to be intercalated with the andesite porphyry.

Veinlets of psilomelane lie in the fissure zone, and in places extend into the wall rock. These stringers commonly are 2 or 3 inches thick, but in places reach a thickness of a foot or more, and some masses of nearly solid ore were said to have reached a thickness of 3 feet. The ore in these veinlets appears to be nearly pure psilomelane, stained by a little iron oxide. It is hard blue black and massive, has a conchoidal fracture and botryoidal structure. An assay was quoted of 50 percent manganese, 1.64 percent silica, and the shipment to the Metals Reserve Company ran 50.67 percent manganese, 9.80 percent silica, 2.50 percent iron, 0.20 percent zinc, 1.20 percent aluminum, and a trace of phorphorus.

In the main mass of the fissure zone the manganese, mostly in the form of psilomelane, with only a little soft black sooty oxide, is mixed with more or less clay and the porphyritic rock fragments. The larger of these rocks may be sorted by hand. It is planned to beneficiate the remainder of the material by washing. Assays of the general run of this material, before and after washing, are as follows (assayed by Smith-Emery & Company, July 9, 1942):

	Run of mine, (percent)	*Run of mine, after washing, (percent)*
Mn	22.15	38.52
Acid insoluble residue	44.32	37.48
SiO_2	2.62	2.06
P	.25	--

This type of ore seems to be particularly amenable to concentration by washing. It is noted that the silica content is very low in the original material, and constitutes no problem. The main impurity is clay and porphyritic rock fragments. The clay may be washed off, and the manganese, being in the form of hard massive psilomelane, does not break up and form slime as do the softer oxides. The main difficulty with the ore is the presence of the porphyritic rock fragments. Many of these may be sorted out by hand, but some of the smaller pieces are intimately associated with the manganese and appear in the final product. Ten tons of the higher-grade ore had been sorted and shipped to the Metals Reserve Company stock pile at Auburn at the time the property was visited.

MONTEREY COUNTY

No. 1. Evans Manganese Prospect. (By F. S. Hudson, July 11, 1918.) A claim for manganese on government land, held by W. J. and J. C. Evans of San Simeon, is located in the SW¼ sec. 24, T. 24 S., R. 6 E. The outcrop is on the north slope of Devil's Canyon, 0.8 mile east of its confluence with the north fork of San Carpojaro Creek. The elevation is 1,700 feet above sea level. A considerable body of chert is present, within which occurs a bed of manganese ore. The ore bed is exposed for 30 feet along a strike of N. 70° W. The dip is 65° N. The eastern 15 feet of the bed exposed is 4 to 5 feet wide. To the west the thickness is only a few inches.

All the surface ore is completely oxidized and appears to be a mixture of black oxide and silica. Porous cores of white silica were seen, from which fact the primary ore may be supposed to carry considerable manganese carbonate. Layers of brown chert carrying spherules of rhodochrosite occur within the ore bed. W. J. Evans reports that thorough sampling showed the ore to carry 46 percent manganese. However, a sample taken across 4 feet of the ore bed, carried 39.8 percent manganese, 26.5 percent insoluble, and 1.4 percent iron oxide.

No. 2. Ross Ranch Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 50, 1918.) The Ross Ranch prospect is 1 mile from the ocean and 3 miles north of the mouth of San Carpojaro Creek, in the extreme southwest corner of the County, probably in sec. 31, T. 24 S., R. 6 E. The deposit is similar to those in San Luis Obispo County in the same range to the southeast. A recent assay of a random sample gave 40 percent manganese, and the deposit is said to be promising. J. Dutra Ross of Cambria is the owner.

No. 3. Wayland Ranch. (By F. S. Hudson, June 19, 1918.) The Wayland Ranch deposit is in the E½ sec. 9, T. 22 S., R. 13 E., about 1.5 miles northwest of the Stone Canyon coal mine. Several large bodies of chert from the Franciscan group are found in this region. The chert for the most part is thin-bedded and red. Prominent chert outcrops in sections 16, 9, and 5 were examined. No manganese was seen except for thin films coating fissures in the chert.

NAPA COUNTY

No. 1. Adams and Westendorf Claims. (By E. F. Davis, July 1918.) The Adams claim was located by Thomas Adams of Monticello. It is in sec. 32, T. 11 N., R. 4 W., 3 miles north of the old Adams place on the road from Monticello to Mysterious Valley. It could be reached by building 3.5 miles of road to the road from Monticello to Lower Lake and then would be 17 miles from Monticello and 36 miles from Winters, the nearest railroad station.

The ore occurs in association with peculiar cherty rocks in a body of basic lavas and pyroclastic rocks of Franciscan age. The manganese-bearing beds form a definite member of the sequence here and are conformable in strike and dip with the igneous rocks. The general strike of the strata is N. 30° W., and the dip is 40° SW.

At the base of the section is a rather massive, extremely fine-grained greenstone in which no definite layering or structure is apparent. Resting on this fine-grained greenstone are the manganese-bearing beds having a thickness of 50 feet at the place where best exposed. Above the manganiferous beds is a moderately fine-grained but distinctly crystalline basic lava the thickness of which was not determinable.

The lava is overlain by clastic rocks, apparently basic tuffs, which include a peculiar breccia containing angular to subangular boulders of fine-grained greenstone. In this breccia are a few subangular blocks of coarse-grained gabbroic rocks enclosed in a fine-grained green matrix.

This rock is regarded as a basic agglomerate. The clastic rocks above the manganese beds and the lava overlying them show a well-marked stratification parallel to that of the manganese beds below.

The manganese beds may be traced on the surface for a distance of 1,000 feet. Several lithologic types are found among these beds. They occur in lenticular strata 1 foot to 10 feet thick, and the various types alternate with one another in an irregular manner. One of the characteristic types is a deep yellowish-brown chert having a somewhat porous texture and breaking easily under the hammer. This chert is cut by veins of compact jaspery material and contains lenses of reddish chert parallel to the bedding. Another type, which is present in small amounts, is a soft open textured red rock which crushes to a bright red powder and is a siliceous iron ore. On exposed surfaces it is black and appears to contain a little manganese.

The greatest amount of manganese is contained in rocks which previous work has shown to be a mixture of opal with iron and manganese oxides. The iron and manganese oxides are finely divided and disseminated through the opal, giving it a uniform color and appearance. The material is rather brittle, having a hardness of 3 to 4, and breaks with extremely smooth surfaces along gently curving fractures. It possesses a very brilliant luster and, like obsidian, shines brightly in the sunlight.

The most abundant variety of this material is dark brown when viewed on newly broken surfaces. One variety, apparently containing more manganese, is black throughout and resembles in appearance some of the black solid bitumens. Another variety is bright red, though in all other respects it is like the other varieties of this material. It occurs in small amounts in bands and lenses interbedded with the brown variety. It is also in minute spherules and little lenses, visible with the aid of a hand lens, scattered through a matrix of the brown variety.

Occasionally the brown material contains a band of red jasper. Some of it appears also in the porous yellow-brown chert referred to before. The amount of this red jasper is small. In a few places it contains spots which resemble radiolaria in their outlines when examined under a hand lens, save that they are somewhat larger than the radiolaria seen in the ordinary radiolarian cherts of the Franciscan. The porous yellow brown chert makes up 75 percent of the volume of the ore, and the opaline iron manganese mixture constitutes most of the remainder. Other varieties are present only in small amounts. Though search was made, nothing was seen resembling the ordinary bedded radiolarian chert commonly found in the Franciscan group.

This type of deposit is considerably different from the ordinary manganese ore deposits of the Franciscan, which are interstratified with bedded radiolarian cherts. Deposits of this peculiar type have been seen before in this general region in northern Napa and southern Lake Counties, usually closely associated with exposures of greenstone of the Franciscan, but the relations between ore and igneous rock have been uncertain.

In this place, however, the relations are clear. The manganese bearing beds are interstratified with igneous rocks, in part clastic, in part massive. Whether the manganese-bearing beds are marine sediments or had some other origin cannot be stated until it is determined whether or not the jaspery bands carry radiolaria.

The Westendorf claim lies on the northwest end of the same zone of manganese beds as appears on the Adams manganese claim, and was located to abut upon the Adams claim. The manganese-bearing material here may be traced continuously from the Adams claim. This claim was located by P. J. Adams of Monticello. The ore is associated with greenstone as on the Adams claim, except that it contains greenish opaline material and cores of white porous silica which were not noticed at the first locality.

No. 2. Bacon and Kenney Prospect. (By E. F. Davis and F. S. Hudson, August 9, 1917.) The Bacon and Kenney prospect is in sec. 19, T. 7 N., R. 5 W., 3.5 miles west of Oakville. It is reached by road from Oakville, the distance by road being about 5 miles. The prospect is near the summit of the divide between Sonoma Creek and Napa Creek at an elevation of 2,215 feet. It is owned by Thomas P. Bacon of Oakland. The ridge, on which the prospect is located, consists of sandstone, with subordinate conglomerate, and greenstone, both of the Franciscan group. The latter makes up the higher parts of the ridge. Included in the greenstone are several blocks of radiolarian chert altered to a bright-vermilion color by the action of the intrusive greenstone. The chert inclusions range from a few inches up to 20 feet in diameter. The manganese occurs as impregnations and in small veinlets in the chert. The possibility of developing manganese ore at this place is small.

No. 3. Blue Monday (Searchlight, Surprise) Claim. (By E. F. Davis, June 11, 1918.) The Blue Monday claim is about 15 miles from Monticello and 38 miles from Winters, the nearest railroad station. It is close to the road from Mysterious Valley to Monticello at a point on the road known as Dollar Greasewood Hill. It is probably in sec. 8, T. 10 N., R. 4 W. The claim takes its name from Blue Monday Peak which lies to the west. This property was first located in July 1916, by Ralph A. Dollarhyde of Pope Valley, as one claim, known as the Blue Monday. In October 1917 two claims were located on the property. The northern part was located as the Surprise claim, by J. W. Charge. The southern portion was located by W. R. Henson, and called the Searchlight claim. In June 1918 the Blue Monday claim was relocated by Henry Hermann.

Ore crops out in three places on this property. The first outcrop is just south of the Mysterious Valley Road. Here a body of manganiferous iron ore is exposed at two points on a curve in the road. The ore zone is 5 feet wide and extends for 125 feet. It strikes northeast. The ore consists of a mixture of iron and manganese oxides permeated by opaline silica. It is soft, brittle, red brown, and has a vitreous or resinous luster. Included in this opaline manganiferous iron ore are bands and streaks of red chert.

The second outcrop is about 750 feet north of the first one and is on an elevated point separated from the road by a deep canyon. It is heavily stained with black manganese oxide and presents a striking appearance when viewed from a distance.

At this place the ore zone is 32 feet thick and 100 feet long. It strikes east and dips 60° S. The ore body is divisible into two parts. The lower 12 feet consists of a yellow-brown chert which is soft and porous. This chert occurs in massive beds from 2 to 4.5 feet thick. These beds are separated from one another by partings of iron rich siliceous shale. The yellow-brown chert contains irregular lenticular patches of compact reddish-brown jaspery material, most of the lenses being an inch or so thick. A few are a foot in length. They lie parallel to the bedding. The yellow-brown chert shows a streaky appearance owing to the presence of very fine lenticular bands of the reddish-brown jaspery material parallel to the bedding. The walls of some veinlets are composed of the same reddish-brown material as though silica had been introduced into the more porous yellow-brown chert along the walls of the vein.

The material of the lower part of the zone contains manganese which appears as a black coating on exposed surfaces and as a filling in innumerable small veinlets cutting the porous chert. An assay of a sample of the material in the lower part of the ore zone gave the following result: manganese, 2.25 percent; ferric oxide, 18.81 percent; and silica, 66.4 percent.

The upper 20 feet of the ore zone consists of opaline manganiferous iron ore containing intercalations of yellow chert. The chert makes up about 20 percent of the upper part of the ore zone. It occurs in lenticular beds and lenses whose thickness is 1 inch to 2 inches. These beds in a general way are parallel to the bedding of the lower part of the ore zone, but some chert lenses make small angles with one another or follow gently curving courses.

The opaline manganiferous iron ore is soft and rather brittle, breaking down easily to a reddish-brown powder. It is full of curving fracture cracks which cause it to break easily into small blocks. It is dark reddish-brown or black, and has a peculiar waxy luster which in places is resinous (neotocite?). A sample of this material, rejecting the silica lenses, gave the following assay: manganese, 6.3 percent; ferric oxide, 62.22 percent; and silica, 26.77 percent.

The third outcrop occurs 300 feet west of the second locality near the bottom of the canyon which separates the first and second localities. The material is reddish-brown opaline manganiferous iron ore, containing bands of jaspery silica, and in all respects is similar to the ore in the other places described.

The region around Dollar Greasewood Hill consists largely of serpentine of the Franciscan group but in the immediate vicinity of the ore is much diabase and basalt. The ore bodies are surrounded by basalt, but since the contacts are nowhere exposed, the relations of this rock to the ore are not known. A body of diabase in the north end, comes within 10 feet of the outcrops of the ore. The bedding of the ore zone strikes directly against the contact with the diabase, and it therefore seems certain that the diabase is later than the ore.

No. 4. Cavagnaro Prospect. (By E. F. Davis and F. S. Hudson, August 11, 1917.) The Cavagnaro prospect is in sec. 3, T. 9 N., R. 6 W., half a mile west of the Aetna Quicksilver mine, at an elevation of 2,200 feet. It is owned by Charles Cavagnaro of Middletown. The ore body has a thickness of from 4 to 6 feet and may be traced for a distance of 100 feet. It trends S. 55° W. and is surrounded by serpentine, except on the southwest end where it is cut off by greenstone. Near the manganese prospect the serpentine is altered to quicksilver-bearing rock, which shows some traces of cinnabar.

A small amount of red chert is in the ore body, but the greater part consists of a massive, rather brittle, brown material of vitreous to resinous luster with a hardness of 4. This material contains manganese in the form of films on the walls of small fissures and also in small spherules, having a diameter of about 1 millimeter. In certain places the brown material contains spherules of rhodochrosite, the alteration of which results in the spherules of manganese oxide. Qualitative chemical tests show that this brown material consists principally of iron oxide with a small amount of manganese oxide. A small percentage of silica is present in the form of opal which remains as a white residue after treating the material with hydrochloric acid. No solid masses of manganese oxide are found here. Quantitative determinations of the amount of manganese oxide have not yet been made, but is is doubtful that this deposit would be valuable as a source of manganese.

No. 5. Conn Valley Prospect. (From files of U. S. Geological Survey, 1942.) A deposit is reported from Conn Valley in sec. 2, T. 7 N., R. 5 W. No ore has been produced.

No. 6. Hastings Prospect. (From files of U. S. Geological Survey, 1918.) A deposit owned by Lyle Hastings is located 12 miles from Pope Valley, half a mile S. 36° W. from Snell Peak. The beds strike east and dip 60° N. The quantity of ore present is small. A typical sample assayed 15.6 percent manganese, 1.25 percent iron, and 68.4 percent silica.

No. 7. Lewis Prospect. (By E. F. Davis, July 17, 1918.) Allen Lewis of Monticello has a manganese prospect on his homestead in the SW¼SE¼ sec. 20, T. 9 N., R. 4 W. A half interest in this prospect is owned by Glenn C. Griffin of Monticello. Here an area 100 by 100 feet is covered by massive red chert. Radiolaria are distinctly visible in this chert which is stained black by manganese oxide. It is massive and in places has a nodular structure. The nodules are separated by bands of reddish shale. The area of chert is surrounded by greenstone of the Franciscan, but the relation between chert and greenstone could not be determined. The chert contains less than 1 percent manganese. There is no indication of the presence of an ore body.

No. 8. The Liberty Claim. (By E. F. Davis, July 2, 1918.) The Liberty claim was located by George E. Tarry of Aetna Springs. It is in the SW¼NE¼ sec. 31, T. 10 N., R. 5 W., the location notice being about 25 yards from the section line. Here a small body of massive, bluish gray to white, rather porous chert containing bands of iron-rich shale is surrounded by serpentine. The relations of the chert to the serpentine are not clear. The chert contains minute veinlets of manganese oxide and is stained on its surfaces by black oxide of manganese. The content of manganese is less than 5 percent and the prospect is of little value.

No. 9. Lombardi Prospect. (By E. F. Davis, June 30, 1918.) Paul Lombardi of Pope Valley has located a deposit of opaline iron manganese ore in sec. 13, T. 10 N., R. 5 W., about a mile east of his place on Putah Creek. A sample taken from this claim gave the following result on assay: manganese, 3.5 percent; ferric oxide, 41.2 percent; silica, 39.1 percent; and ignition loss, 9.1 percent.

No. 10. Moore Creek (Manganese Ridge) Prospect. (By E. F. Davis, June 1, 1918.) The Moore Creek property is owned by Charles E. Wolcott of the N. K. Speet Company in San Francisco, and by others. It is in sec. 15, T. 8 N., R. 5 W., adjoining the property owned by L. W. Uhl. Manganese Ridge is a spur of the main ridge that separates Conn Valley and Moore Creek. The manganese deposits occur at an elevation of about 1,200 feet, on the south slope of the ridge a little below its summit. The property is reached by road from St. Helena through Conn Valley, St. Helena being the nearest railroad point. Ore is hauled from the mine by wagon for a mile over a rough road. It is then loaded into motor trucks and hauled to St. Helena, a distance of 6 miles. At the time this property was visited in August 1917, it was idle, though some development had been done many years before. In 1917 a small amount of high-grade oxide ore was exposed in the old workings, together with 100 tons of ore containing moderate amounts of silica.

The ore occurs as lenses in thin-bedded red radiolarian chert and shale. It is in close association with thick beds of massive red jasper that are in the form of lenses in the thin-bedded chert. The attitude of the enclosing chert varies greatly, and the chert is considerably broken at many places. On the east end of the property the chert appears to dip northwest at a low angle, whereas on the west end it stands nearly vertical and in general strikes east.

The ore now remaining on the property is siliceous. At the surface it consists of an intimate mixture of black manganese oxide and silica. One may find all variations from manganiferous chert to ore consisting largely of manganese oxide with small amounts of silica. The better ore forms pockets in the more siliceous material and also occurs along fracture planes and as coatings on blocks of the more siliceous ore. The black oxides commonly contain patches and cores of white porous silica.

In the deeper parts of the workings and on the interior of the larger blocks of massive ore is another type of ore. This type is reddish to dark brown, somewhat resembling chert but showing a granular texture (bementite?). It is hard and contains a considerable proportion of chalcedonic silica. This brown ore represents the primary material of the ore body. Upon exposure at the surface it oxidizes. The ore materials range between a nearly pure pink chert and a dark-reddish brown ore of high specific gravity. The difference appears to be due to variation in the proportion of silica intermixed with the manganese mineral. The amount of silica which is mixed with the manganese mineral varies from place to place in the ore body. In some places the variation is gradual, but in others it is abrupt.

Two open cuts are on the east end of the ridge; the area of each is about 10 by 10 feet. On the west end of the property an open cut about 30 by 30 feet, averaging about 8 feet deep, has been opened. Here a pit sunk to a depth of 10 feet reveals little ore. An old tunnel started in the early days at a level about 50 feet below the open cut, has been retimbered and is being driven with the hope of striking at depth the ore zone that was worked in the upper open cut. The property has produced about 300 tons of ore. The ore was hand sorted before hauling, and the average grade was 44 percent manganese and 19 percent silica.

No. 11. Nichelini Prospect. (By E. F. Davis, June 2, 1918.) The Nichelini prospect in sec. 33, T. 8 N., R. 4 W., is owned by A. Nichelini of Chiles. Only a small amount of ore is exposed. It is soft and contains much manganese dioxide, but its silica content is high, owing to the presence of cores of white porous silica. A trench should be cut across the outcrop of this material to determine whether good ore is associated with the more resistant siliceous material, though it seems probable that the prospect is valueless.

No. 12. Powers Mine. (By E. F. Davis, June 2, 1918.) The Powers mine is owned by G. E. Powers of Rutherford and associates. It is in the S½ sec. 29, T. 8 N., R. 4 W., on the west side of the ridge that is just west of Chiles Valley. It is about 200 yards west of the summit of the ridge. The mine is best reached from Rutherford, a distance by road of about 10 miles. The Sage Canyon road from Rutherford is followed to Moore Creek, then the Moore Creek road to the old Chiles Mill, turning southwest on county road from Chiles Post Office to Pope Valley for a distance of approximately 2.3 miles. Here a rough road runs west up the ridge and crosses the divide between the Moore Creek drainage and Chiles Valley. The mine is near the place where the road first reaches the summit of the divide.

The ore occurs in a body of bedded radiolarian chert that caps the ridge in this region. It forms a zone 10 feet thick which is enclosed in, and is parallel to, the bedding of the radiolarian chert. It is pink to red thin-bedded, and strikes N. 50° W., and dips southwest at angles between 20° and 40°. The enclosing chert contains some manganese in veinlets and fissure fillings, but the actual amount is small. The material of the zone is stained black.

The ore zone itself is rather complex in its structure. It consists of lenticular beds, short lenses, and nodules of manganese ore and chert separated from one another by partings and interstitial fillings of shale. The nodules are usually elliposidal with the longer axes parallel to the dip of the ore zone. The dimensions of these bodies vary considerably. Some small nodules are less than an inch in diameter. One lens of massive ore is 5 feet wide and at least 10 feet long. A great many lenses are 2 or 3 feet long and 2 to 4 inches thick. Some lenticular beds 1 inch or 2 inches thick may be traced for several feet and show a marked tendency to pinch and swell. The larger bodies of ore, 2 to 5 feet thick, make up about half the volume of the ore zone; they are irregularly distributed among the smaller lenses and nodules which fill the rest of the zone. As the larger bodies pinch out their place is taken by smaller lenses.

The shale which fills the spaces between lenses of ore is of two varieties, red and gray. The shale is soft, rather loose textured and is given a dark color by innumerable fissures filled with black manganese oxide. The ore zone contains a few lenses and small nodules of red chert of the ordinary variety. Most of the material, aside from shale partings, is a rather siliceous manganese ore.

Near the surface the ore consists of black oxides of manganese with considerable intermixture of silica in the form of white porous cores. Occasionally this porous silica is stained pink by small amounts of iron oxide. Also, streaks and patches of ordinary red chert lie in the ore. Many specimens of oxide ore possess a waxy luster and a smooth conchoidal fracture. They lack the dull metallic, almost velvety luster of pure psilomelane. The difference is due to finely disseminated silica. At greater depths and on the interior of the larger, more massive bodies, is another variety of manganese ore which is pink to dark brown, apparently varying in appearance with variations in the relative amounts of silica and manganese mineral.

This material is the primary ore of the deposit and oxidizes near the surface. It contains little ''available oxygen'' and appears to consist of an intimate mixture of chalcedonic silica and an oxide of manganese.

In the process of oxidation by descending surface water some of the manganese is removed in solution. By this leaching, localized areas lose their manganese content and the silica is left behind as a porous skeleton, forming patches of porous silica in the oxide ores near the surface. A sample, representative of the unoxidized ore, consisting of a brown silica-manganese mixture, with a few veinlets and streaks of oxidized material, gave the following results: manganese, 17.8 percent; silica, 66.9 percent; available oxygen, 0.97 percent.

One hundred feet northeast of the main working is an outcrop of massive siliceous ore. This is thinner than the first but of the same nature and apparently represents another horizon of ore below the first. No ore has ever been produced from this property and since it has been fairly well opened up, it seems useless to expect the discovery of a better grade of ore here.

No. 13. Ries and Jacobsen Prospect. (By E. F. Davis, June 10, 1918.) R. M. Ries and Oscar Jacobsen of Pope Valley have a manganese prospect in sec. 18, T. 10 N., R. 5 W., about half a mile southeast of the Valentine Kramer Ranch. The deposit is 1.5 miles from the Butts Canyon road from Middletown to Pope Valley, and if worked it would be necessary to construct a road for that distance. The prospect would then be 22.5 miles by fair road from St. Helena. The deposit lies within a body of jasper 600 feet square. It is exposed in two trenches. A tunnel has been started to cut the ore body at depth but has not yet gone far enough to reach it.

The manganese occurs as a massive siliceous bed 5 to 6 feet thick, enclosed in thin-bedded radiolarian chert. The enclosing chert strikes at varying angles but dips 50° to 60° NE. A few thin seams of similar siliceous ore are also intercalated in the enclosing chert. The exposed ore is entirely in the form of black manganese oxides containing much silica in porous cores and streaks of red chert. The ore contains about 20 percent manganese and 55 percent silica.

No. 14. Wallace Prospect. (By E. F. Davis, July 7, 1918.) G. P. Wallace of Pope Valley has a prospect of manganese near Walters Springs in sec. 13, T. 9 N., R. 5 W. A specimen brought from the property by Mr. Wallace was assayed by the U. S. Bureau of Mines with the following results: Manganese, 7.2 percent; ferric oxide, 57.2 percent, and silica, 15.2 percent.

NEVADA COUNTY

No. 1. Arnold Deposit. (By Ivan F. Wilson, February 16, 1943.) The Arnold deposit is located on Lime Kiln Ranch in sec. 5, T. 14 N., R. 8 E. It is 2.5 miles by road west of the highway between Auburn and Grass Valley, and is reached by turning west at a point about 15 miles north of Auburn. The deposit is owned by Max F. Arnold, Wolf Route, Auburn. Development consists of a bulldozed cut 50 by 30 feet and 10 feet deep, and one shaft 20 feet deep. The shaft was full of water when visited and the bottom of the cut was caved.

The owner stated that two pockets of ore were found, each of which terminated within the workings. At the bottom of the shaft the ore is said to have pinched into a seam of 3 inches thick. About 2 or 3 tons was mined and placed in a stock pile. Apparently this was the entire quantity of ore present. The ore minerals consisted of material of the psilomelane type and of sooty black oxide. The grade was estimated to be 45 percent manganese. The ore body was enclosd in chert, which in turn was surrounded by greenstone and a highly altered igneous rock, which weathers largely to clay.

No. 2. Black Ledge Prospect. (By N. L. Taliaferro, September 1, 1918.) The Black Ledge deposit is 6 miles northeast of Colfax in sec. 12, T. 15 N., R. 9 E. It is owned by J. H. Bastiani and Lavina Richards and is leased to Richard Reehnagle of Auburn. The deposit is a typical central Sierra Nevada rhodonite deposit weathered to oxide at the surface. The average grade of the ore is about 25 percent manganese. The bed crops out for a distance of 30 feet and has an average width of 6 feet. It has produced no ore of shipping grade.

No. 3. Black Squirrel Prospect. (From files of U. S. Geological Survey, 1918.) The Black Squirrel deposit is located on Bear River Ridge and is owned by John C. Talbot of Dutch Flat. It is low grade and is undeveloped.

No. 4. Gleason Deposit. (By Ivan F. Wilson, February 16, 1945.) The Gleason deposit is located between the Manga-Chrome (Nevada 6) and the Smith (Nevada 14) properties, probably in sec. 29, T. 14 N., R. 8 E. It is owned by a Mr. Gleason of Auburn, and was formerly leased to Chas. Neville, et al., of Auburn, who did some development work. Later it was leased to Chas. C. Stearns and Douglas E. Owens of Auburn. The property is 0.2 mile north of the Smith deposit. The intervening distance is practically level.

The deposit is in the same belt of chert and phyllite which encloses the ore at the Manga-Chrome and the Smith deposits. A cut has been bulldozed for a length of 50 feet, width of 15 feet, and depth of 6 feet. This cut exposes a bed of cherty manganese ore 2 feet wide enclosed in chert and phyllite, which in turn is enclosed in greenstone. The beds strike N. 25° W. and dip 70° NE. The ore apparently is low grade, probably containing less than 35 percent manganese. The length of the ore body was not determined, and it is exposed in only one place.

No. 5. Good Enough 1 and 2 Claims. (Modified slightly from original description in California Div. Mines Rept. 37, p. 441, 1941.) The Good Enough 1 and 2 claims are probably in the north part of sec. 9, T. 16 N., R. 8 E. They are owned by Wm. Rose. An ore body 35 feet in length and 4 feet in width is said to be on these claims.

No. 6. Manga-Chrome Mine. (By Ivan F. Wilson, August 7, 1942.) The Manga-Chrome mine is on the Duggan Ranch in the south part of sec. 17, T. 14 N., R. 8 E. It is on the Wolf road, 2 miles west of Higgins Corners, which is 10 miles north of Auburn along State Highway 49. The nearest shipping point is Auburn, on the Southern Pacific Railroad 12 miles distant by good roads. The mine is on the flank of a hill sloping gently down toward the southwest. The property on which the mine is located is owned by Dan Duggan, Wolf Route, Auburn. It is leased by the Manga-Chrome Company of Auburn including in its membership Charles H. Neville, Glen V. Slater, and Howard Taylor.

The major development is a cut 340 feet long trending N. 30° W. On the uphill side it is 25 to 30 feet deep in the center and 10 to 15 feet deep at each end. At the northwest end of the cut is an old shaft 20 feet deep and a drift 20 feet long, which were constructed during World

War I. These have filled and were not accessible in 1942. Other smaller exploratory cuts have been made with a bulldozer about 700 feet northwest of the main cut, northwest of the Duggan house; and also about 1,000 feet northeast on the northeast slope of the hill.

The mine is located in a group of rocks shown on the State Geologic Map as the Calaveras formation, but they may belong to the Amador group. It is within a general belt of chert and slate which extends at least 500 yards northwest of the mine. Two miles southeast the same rocks were traced for half a mile and are thought to be continuous with the belt at the mine. The rocks include massive red and white chert, well-bedded red and white chert, slaty chert, white to gray slate, and some gray phyllite. In places bedded purplish-red chert was seen, composed of well-defined beds 2 to 4 inches thick separated by softer cherty shale partings a quarter to a half inch thick. The chert is cut by small quartz veinlets, but no large quartz veins were seen.

The chert and slate are intercalated with sills of gray diabase, highly altered green diabase or fine-grained diorite (probably metadiorite), and a highly altered and decomposed green porphyritic rock which might be called "greenstone." The manganese ore bodies encountered in the main cut seem to lie along a contact between cherty slate and these altered igneous rocks. The general belt of chert and slate is bordered on the northeast by serpentine. The strike of the rocks on the northeast face of the main cut ranges from N. 20°-40° W., averaging N. 30° W. The dip is 60° to 80° NE.

The following is a section of the rocks exposed near the center of the main cut from northeast to southwest:

	Thickness (feet)
On slope above cut.	
Massive white chert	15
No exposure	30
Greenish-gray to white slate with some chert	15
Sill of gray diabase, bordered by zones of red clay—possibly the result of the baking of wall rock. (This greenstone cannot be traced far along the strike but masses of greenstone appear at various horizons.)	
On wall of cut.	
Gray to white slate. Mottled appearance, grayer inside, weathers white. Some beds siliceous, others clayey. Faint sheen on surface from development of sericite. Beds 1 inch to 4 inches thick. Many fracture planes in addition to bedding planes. Grades into slaty chert and red and white chert at southeast end of cut	15
At base of cut.	
Gray phyllite. More massive and softer than slate; shows elongated grains—probably derived from sandy shale	10
Manganese ore bodies. Exposed mainly at only one place near center of cut; other ore bodies may not necessarily be at the same horizon	0–10?
Various highly altered and decomposed igneous rocks—green diabase or fine-grained diorite or metadiorite, porphyritic "greenstone"—makeup most of the floor of the cut along with some phyllite. These rocks are extensively altered to clay	about 50?
Southwest edge of cut now covered with fill, but along strike to northwest is massive white chert.	

The greatest amount of ore has been obtained from one pipelike body located about 200 feet northwest of the southeast end of the cut. Its width is said to have ranged from 5 to 14 feet, and its length from 6 to 18 feet.

On both sides of this mass, but mainly to the southeast, a series of narrow lenses of ore trend approximately N. 10° E. at an angle with the strike of the enclosing beds. About 12 of these lenses are said to have been exposed, averaging 20 feet apart, 20 feet in length and 9 inches in thickness. At the time of the writer's visit only two or three small bodies of ore, in addition to the pipelike body, were visible on the bottom of the cut. The ore in these smaller lenses tends to become mixed with the clayey wall rock. Most of the ore which is sorted by hand has come from the larger pipelike body mentioned above.

Several different manganese minerals are represented, including pyrolusite, psilomelane, manganite (?), rhodonite, and rhodochrosite. A large part of the ore shipped is pyrolusite, some of which is beautifully crystallized, but some of it is noncrystalline, earthy, and sooty. Some of the ore in the pipelike body is massive, gray, hard, heavy, and has a distinctly brown streak. This ore is believed to be manganite. The Metals Reserve Company, purchaser of the ore, had a special rhodonite analysis in which the amount of manganese computed as rhodonite is subtracted from the total manganese percentage paid for. Analyses of the ore shipped reveal 6 to 10 percent rhodonite. The operators claim that the quantity of rhodonite decreases with depth. Rose-colored rhodochrosite was seen as small veinlets cutting some of the ore specimens.

The production of this mine during 1942 was 250 tons shipped to the Metals Reserve stockpile at Bowman, 2 miles northeast of Auburn. An analysis of a typical shipment of 25 tons gives:

Material	Percent	
Mn	49.49	
Rhodonite	6.54	
Mn as rhodonite	2.74	
Mn as oxide	46.75	(basis on which payment made)
SiO_2	9.90	
Al_2O_3	3.00	
Fe	4.4	
P	0.002	
Zn	0.3	

No. 7. Mangatop (Wren Ranch) Prospect. (By N. L. Taliaferro, 1918). The Mangatop prospect is 12 miles north of Auburn in the south part of sec. 20, T. 14 N., R. 8 E., about 1 mile southeast of the Manga-Chrome mine (Nevada 6). It is owned by R. M. Wren of Placerville and leased to C. E. Loofbourrow of Oakland. The ore body is exposed for 14 feet and averages 10 feet in width. The average grade of ore is 25 percent manganese. A shaft has been sunk to a depth of 20 feet. The deposit is said to have produced 35 tons of ore in 1918 containing 45 percent manganese and 7 percent silica. Ivan F. Wilson visited the deposit in August 1942, and found that the shaft was full of water and that the deposit had not been worked since World War I.

No. 8. McCarty Prospect. (From files of U. S. Geological Survey, 1918.) The McCarty prospect is on Little Greenhorn River 7 miles east of Nevada City, probably in T. 16 N., R. 10 E. It is said to be owned by Jack McCarty.

No. 9. Mebam Deposit. (By Ivan F. Wilson, February 17, 1943.) The Mebam deposit is 1 mile north of the Manga-Chrome (Nevada 6) mine in sec. 9, T. 14 N., R. 8 E. It is 0.3 mile by trail east of the Wolf Creek road. It is owned by J. R. Mebam and Bob Cole of Auburn. Three prospect pits are situated at intervals over a distance of 1,500 feet along the top of the ridge. These pits lie in a belt of massive and thick-bedded red chert. The chert strikes N. 30°-45° W., and dips 70° to 85° NE. The chert is stained with manganese oxide. In the pits outcrops 5 to 10 feet wide of "stockwork" ore are penetrated with manganese and iron oxides. More iron is present than manganese. An assay from one of the pits gave the following results: manganese, 11.42 percent; iron, 35.69 percent; and silica, 20.50 percent.

No. 10. Paine Brothers Claims. (By Ivan F. Wilson, August 5, 1942.) The Paine Brothers claims are 11 miles northeast of Nevada City in the NW¼ sec. 15, T. 17 N., R. 9 E. They are reached by proceeding from Nevada City along the New Bloomfield road for 10 miles, then turning south for an additional mile. They lie at a break of slope on the north bank of the South Fork of the Yuba River. The claims are owned by D. R. Paine and brother, of Nevada City. They were located for gold, and the only development has been for gold in "porphyry dikes," and not in the manganiferous rocks. The gold development consists of several cuts, tunnels, and shafts, which were not entered by the writer.

The manganiferous rock appears to be a gossan of iron and manganese oxide in irregular areas coating the surface. They were noticed in one area about 10 by 20 feet, and another about 10 by 10 feet. The material is mostly porous, red to brown, and stained with crusts of blue-black psilomelane. Most of the material seemingly contains more iron than manganese. The manganese content probably does not average over 10 percent. This manganiferous material grades into siliceous wall rock stained with manganese.

The wall rocks are chiefly gray slate or phyllite and white cherty slate or metachert, in part recrystallized to fine-grained quartzite, but in part unrecrystallized. The general strike of these rocks ranges from N. 45° W. to North, and the dip is 60° NE. to nearly vertical. The rocks in this area are regarded as Calaveras. They are cut by "porphyry dikes" 2 to 10 feet thick, which are said to contain stringers bearing gold. The dikes are of a highly altered, soft and crumbly porphyritic rock now rich in hematite and limonite.

No. 11. Pharo Deposit. (By Ivan F. Wilson, February 17, 1943.) The Pharo deposit is half a mile by road south of the Lime Kiln Ranch, probably in sec. 8, T. 14 N., R. 8 E. It is on property owned by W. H. Pharo of Wolf Route, Auburn. The deposit is on the brow of a low ridge across a creek about 500 feet south of the Pharo ranch house. A small prospect pit has been dug. Low-grade manganiferous iron ore occurs in a belt of massive dark-gray chert 10 feet thick, which is heavily coated with manganese oxide. The chert strikes N. 20° W., and dips 70° NE. Two types of ore are present: (1) soft, punky, black to brownish-black ore of low specific gravity; and (2) hard, cherty, black ore. The soft ore is 3 feet thick in the prospect pit, and the hard ore is exposed in one place for a thickness of 2 feet. The ore crops out for a distance of 30 feet. Assays of the two types of ore follow (assayed by Abbott A. Hanks, Inc.):

	Soft ore (percent)	Hard ore (percent)
Mn	11.43	5.97
Fe	27.09	27.28
SiO_2	20.35	24.59

No. 12. Ryan Prospect (Midway, Nigger Heaven, You Bet, Bluebird, Bartholf and Veach, and Black Ledge). (By Ivan F. Wilson, August 13, 1942.) "Buck" Ryan of You Bet, owns three claims on the northwest bank of Bear River, 5 miles north northeast of Colfax in sec. 12, T. 15 N., R. 9 E. The claims are called the Midway, Nigger Heaven, and Bluebird. They probably include the same prospect which was called the Bartholf and Veach mine during World War I, and which is said to have shipped 150 tons of ore. It may also be the same as the Black Ledge of World War I.

The prospects are reached from the road toward You Bet, which turns off U. S. Highway 40, 2.5 miles north of Colfax. About a mile along this road above the bridge across Bear River is an abandoned irrigation ditch which follows Bear River for 1.5 miles to the prospect. A road could probably be constructed with a bulldozer, following the grade of this ditch. The nearest rail point is at Colfax, 5 miles distant.

All the development of these prospects was during World War I. A tunnel 20 feet long, inclined slightly downward, runs N. 30° W. into the hill. It is bordered on the southeast by a cut 48 feet long. Up the hill north of the tunnel are two open cuts; one 30 feet long, trending N. 5° W., the other 30 feet long, trending N. 10° W. The total length covered by the tunnel and open cuts is 150 feet along the strike of the ore body.

A manganese ore body is exposed in the tunnel and on the face of the two upper cuts. The ore consists of manganese oxides mixed with white chert and cut by quartz veins. It is apparently a bed enclosed in sericite schist of the Calaveras formation. The best ore now exposed is on the face of the tunnel, where it is 3 feet thick. Part of the ore is siliceous but some of the material may contain 45 percent manganese. The ore in the face of the cut up the slope is also 3 feet thick, but is more siliceous. It contains both white chert and quartz veins. The bed exposed on the face of the highest cut is 2 feet thick and even more siliceous; it is a manganiferous chert, which probably does not run over 10 percent manganese. The average grade of the entire bed would perhaps be 30 percent manganese. Some ore of shipping grade could probably be obtained from the tunnel, however.

The average strike of the bed and enclosing schist is N. 15 W., and the dip is 80° E., although in the highest cut the beds have slumped, and dip 45° W. No rhodonite was seen in place, but two or three boulders of rhodonite float were observed in the vicinity. These contained partly oxidized pink rhodonite mixed with granular white quartz.

A cut 30 feet long and several pits have been dug down the slope to the southeast, but none of these have penetrated the rather thick soil that occurs at this place. The cut reveals a boulder 2 feet thick and 7.5 feet long, composed of cherty manganese ore, containing pockets of soft, high-grade pyrolusite. The cut has exposed part of the bottom of this boulder which does not appear to be in place. Some other pieces of float ore occur in the soil in this vicinity, along with fragments of slate, chert, and schist. Several shafts and tunnels were dug below the irrigation ditch in search of gold. Some siliceous ore is exposed along the irrigation ditch in a ravine southwest of the main workings first mentioned. A bed about 6 feet wide, consisting of white chert somewhat penetrated with manganese oxides and cut by quartz veins, is exposed here. This bed is estimated to contain about 15 percent manganese. The strike of this bed and of the enclosing schist is N. 50° W., and the dip is 80° SE.

Ryan Prospect. By Ivan F. Wilson, February 16, 1943.) Since the writer's visit, August 1942, the property has been leased under the name of You Bet mine, to Joseph M. Gross and Myron J. Glauber, of Auburn, and a considerable amount of development has been done. A narrow road has been built along the irrigation ditch for a distance of 1.5 miles to the mine. At the main workings which date to World War I some cuts have been bulldozed. These expose low-grade siliceous ore. Along the irrigation ditch a quarter of a mile southwest of the main workings a tunnel was driven for 40 feet, N. 40° W. into the slope. This tunnel follows a manganiferous massive gray chert. The manganese content is very low, consisting of little more than stains. Short drifts across the strike were run at the end of the tunnel. They expose chert to the southwest, and phyllite to the northeast. The beds strike N. 20° W., and dip 70° NE.

The most recent development is 0.5 mile west of the main workings and 1 mile east of the road between Colfax and You Bet. A shaft 30 feet deep was sunk on a manganiferous outcrop, and a tunnel and open cut 120 feet long have been driven to reach the ore bed. The tunnel trends N. 45° E. from the mouth, crossing chert and phyllite, then swings around to N. 10° W., following the manganiferous zone. The beds strike N. 10°-25° W., and dip 65° to 70° NE. The ore zone consists mostly of low-grade stockwork ore in chert. Material of the psilomelane type and of soft black oxide is scattered through white chert and is cut by numerous quartz veins. The quartz veins reach a thickness of 2 to 6 inches, and dip gently. They cross the ore zone and extend into the wall rock, which is phyllite and chert. The ore zone is about 10 feet thick on the surface at the top of the shaft, but narrows down to a thickness of about 2 feet at the end of the tunnel. An assay of the ore zone exposed in the tunnel gave the following results: manganese, 16.69 percent; iron, 3.36 percent, and silica, 60.27 percent.

Some ore was hauled into the Metals Reserve depot at Auburn during the early part of 1943. The minimum shipment of 10 tons required had not been completed at the time of the writer's visit, but the first truck load assayed ran only 20 percent manganese. It is probable that this is close to the average grade of the material exposed here, and that little or no ore running over 35 percent manganese could be obtained even by careful sorting.

No. 13. Santo Deposit. (By Ivan F. Wilson, February 17, 1943.) The Santo deposit is located on the west side of the Wolf Creek road about a mile north of the Manga-Chrome (Nevada 6) mine. It is probably in the N½ sec. 17, T. 14 N., R. 8 E. It is on property owned by Jack A. Santo, Wolf Route, Auburn. The deposit is 0.3 mile, by trail, west of the Santo ranch house. A pit 10 by 10 by 10 feet, and a tunnel 15 feet long have been opened. They are in massive red chert that contains a few stains of manganese oxide and one stringer 1 inch to 2 inches thick of oxide of the psilomelane type. The chert strikes N. 40° W., and dips 80° NE. It is in contact to the northeast with decomposed greenstone. No ore is in sight on the property, and further development is not recommended.

No. 14. Smith Prospect. (By Ivan F. Wilson, February 16, 1943.) The Smith prospect, in sec. 32, T. 14 N., R. 8 E., is owned by George A. Smith, Wolf Route, Auburn, and is leased to the lessees of the Manga-Chrome mine, Chas. G. Stearns and Douglas E. Owens of Auburn.

A shaft has been sunk to a depth of 15 feet on an outcrop of manganiferous rock, mainly rhodonite, and an open cut has been dug southwest from the shaft. The shaft exposes an irregular body of low-grade oxide ore and partly oxidized rhodonite ranging from a few inches to 2 feet in thickness. The ore now in sight on the walls is neither thick enough nor of high enough grade to be mined economically. On the southwest side of the hill, 50 feet stratigraphically below the ore-bearing horizon, a large open cut was bulldozed. The cut exposes phyllite and some chert. The purpose of this cut is not evident.

One outcrop and manganiferous rock is on the top of a low gentle ridge. This outcrop reveals a bed 6 inches to 2 feet thick, exposed for a length of 15 feet. The bed is chiefly pink rhodonite coated with black manganese oxides. A few pockets and veins of manganese oxide up to 4 or 5 inches thick occur in the rhodonite. At the widest point in the bed the bottom is composed of pink rhodonite, whereas the top consists of massive brown manganese carbonate, and possibly also some neotocite. This brown ore, like the rhodonite, is coated and penetrated with black oxide. The rhodonite bed is in massive white chert, also stained with manganese. The ore is part of a fairly wide belt, 100 to 500 feet thick, which includes massive white and red chert; bedded white chert, in beds 2 to 3 inches thick with thin shale partings; bedded red chert with shale partings; and some greenish chert. All of these rocks are cut by quartz veinlets, and in places are stained by manganese oxides. The chert strikes N. 10° W., and dips 40 to 80° NE. This belt of chert was traced northward for at least half a mile. It is said to continue for 2 miles to the Manga-Chrome mine (Nevada 6). The surrounding rocks were not observed except for one outcrop of a highly altered metavolcanic rock. A belt of serpentine lies to the east. These rocks have been mapped as Calaveras formation but they may belong to the Amador group of Taliaferro.

No. 15. Thompson Prospect. (By N. L. Taliaferro, August 14, 1918.) The Thompson prospect is 13 miles north of Auburn in sec. 17, T. 14 N., R. 8 E. It is owned by H. L. Thompson of Grass Valley. It is a small deposit and is wholly undeveloped.

PLACER COUNTY

No. 1. Cape Horn. (Modified slightly from original description in Arkansas Geol. Survey Ann. Rept. 1890, vol. 1, p. 495, 1891.) In the face of the cliff at Cape Horn in sec. 35, T. 15 N., R. 9 E., on property owned by Daniel Russell of Colfax, is exposed a series of slaty and schistose strata, frequently micaceous and containing numerous veins and lenticular layers of quartz. The rocks strike northwest and dip almost vertically. Manganese is seen in many places near the base of the hill, and occurs in the form of black oxide in thin seams from a sixteenth to an eighth of an inch in thickness. It commonly forms a network of thin veins, but the quantity of ore so far discovered is small.

No. 2. Emma Deposit. (By N. L. Taliaferro, August 25, 1918.) The Emma deposit is 12 miles southeast of Colfax in the N½ sec. 28, T. 14, R. 10 E., and is owned by George M. Duncan of Yankee Jims. The ore body is a typical small deposit of the central Sierra Nevada type. The average grade of ore is about 25 percent manganese. Relatively little ore is in sight. The prospect has not been developed.

No. 3. Gold Hill Mine (Crown Point, Tilsley and Coplen Group of Claims). (By Ivan F. Wilson, August 11, 1942.) The Gold Hill mine, known as the Crown Point claim of the Tilsley and Coplen group, during World War I,[1] is located in sec. 20, T. 14 N., R. 10 E. It is 1.7 miles, by road, northwest of Yankee Jims. It is reached by proceeding along the road north of Yankee Jims for 0.9 mile, then turning off to the east for an additional 0.8 mile. The nearest shipping point is 10 miles to the north at Colfax. The mine is on the crest and upper part of the southwest slope of a ridge, at an elevation of about 2,500 feet. The mine is a claim on government land located by H. R. Stone and Sue H. Eaves of Colfax. Mr. Stone was working at the property when visited.

Along an upper ore body is a tunnel 20 feet long joined by a cut 30 feet long trending N. 55° E. into the hill. A few small shallow cuts lie northeast of the adit. Along a lower ore body, 25 feet west of the above mentioned workings, is a shaft 30 feet deep, another 10 feet deep, and a tunnel 62 feet long, trending N. 40° E. into the hill and connecting with the 30-foot shaft. The last mentioned tunnel has been constructed this year (1942) ; the other workings date to World War I.

The ore at this mine consists of manganese oxides in metachert (white to gray fine-grained quartzite) cut by thick quartz veins and enclosed in yellow to gray sericite schist or phyllite. Some slaty white, gray, and red mottled chert adjoins the ore beds in places. The enclosing rocks have been mapped as Calaveras formation. They strike N. 20°-45° W., and dip 60° to 75° NE. The quartz veins dip gently, chiefly to the southwest. There are two beds of manganese ore in metachert, unless one has been repeated by longitudinal faulting. The upper bed, to the northeast, is exposed in the open cut at the mouth of the upper 20-foot tunnel. At this point is about 15 feet of siliceous ore, containing small pockets of high-grade ore. The ore is cut by quartz veins, one of which is 2.5 feet thick, dipping gently to the southwest. In one or two places the manganiferous metachert shows crosscutting relationships to the adjoining schists, probably as a result of faulting. The ore zone terminates 4 feet inside the mouth of the tunnel, and the rest of the tunnel is in schist. Some ore is exposed by shallow pits on the surface above the tunnel, and possibly has been carried there by faulting. Gently dipping to nearly flat quartz veins occur over a large area north of the tunnel, but carry no manganese.

The lower ore bed is exposed in the two shafts and in the 62-foot tunnel. This bed has a thickness of 5 feet in the tunnel, up to 9 feet in the 30-foot shaft, and 4 feet in the 10-foot shaft. It is a siliceous ore (manganiferous metachert cut by quartz veins up to 6 inches thick) with pockets and lenses 1 foot to 2 feet thick of higher-grade ore. The high-grade ore contains 35 percent manganese. The ore is mostly hard blue-black psilomelane, with botryoidal surfaces and conchoidal fracture. Also present is soft, black pyrolusite, and an unidentified hard black crystalline mineral. Pink rhodonite was seen in fragments on the dump.

In 1918 the production from the Tilsley and Coplen (Placer 6) group of claims, including this claim (Crown Point) and the American claim, is listed as 100 tons, running 45 percent manganese and 15 percent silica. At the time of the writer's visit, Mr. Stone had sent about 5 or 6 tons to the Metals Reserve stock pile at Bowman. This was to be assayed when the shipment totaled 10 tons. Ore is now being obtained from the 30-foot shaft and connecting tunnel.

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[1] California Min. Bur. Bull. 76, p. 52, 1918.

No. 4. Lloyd Prospect. (By Ivan F. Wilson, August 14, 1942.) A prospect is located on the property of E. H. Lloyd of Colfax north of the New England Mills Schoolhouse, half a mile northwest of Weimar. The prospect is on a hill slope 0.3 mile northeast of Mr. Lloyd's house. It is in SE¼ sec. 20, T. 14 N., R. 9 E., at an elevation of about 2,200 feet. A pit 4 by 4 feet and 5 feet deep has been sunk in a regolithic breccia consisting of white chert fragments cemented by black manganese oxides, chiefly psilomelane with botryoidal surfaces, but also some pyrolusite. The manganese content of this breccia probably is not over 10 percent. This chert breccia covers an area of several square feet around the pit. About 100 feet up the hill is exposed a similar chert breccia cemented mainly by hematite, with minor amounts of manganese oxides.

Mr. Lloyd states that seams and pockets of high-grade black oxide ore were exposed in an irrigation ditch during World War I. This is just south of the first mentioned pit in the regolithic breccia. Mr. Lloyd showed the writer a sample of the ore said to have come from here. It consisted of high-grade black oxides—psilomelane and pyrolusite—running perhaps 50 percent manganese. The spot from which this sample is said to have come is now covered by water. On the bank of the irrigation ditch is exposed bedded white chert with shaly partings.

No. 5. Pettigrew-Stafford (Gray) Lease. (By Ivan F. Wilson, August 8, 1942.) The Pettigrew-Stafford lease, probably in the same location as the Gray Lease of World War I,[2] is in the NE¼ sec. 29, T. 14 N., R. 10 E. It is 1 mile, by road, northwest of Yankee Jims, and is reached by a road turning off from the Yankee Jims-Colfax road through an old hydraulic cut 0.1 mile north of Yankee Jims. The mine is located on the crest of a gentle ridge, which slopes toward Mexican Gulch to the north. The nearest shipping point is 11 miles northwest at Colfax. A notice on the property dated August 12, 1941, states that the property, owned by the Southern Pacific Land Company, is leased to Pettigrew, Stafford & Company, including H. L. Robertson, A. H. Stafford, and George V. Pettigrew. The lease expires June 30, 1943. No one was working on the property when it was visited by the writer.

A shaft has been sunk 16 feet. It is 6 by 4 feet at the bottom, and 12 by 10 feet at the top. The shaft reveals massive yellow to white chert and metachert, partly recrystallized to fine-grained quartzite, with pockets of manganese oxides, the whole being cut by quartz veins. The chert is enclosed in buff to gray slate or phyllite. The rocks have been mapped as Calaveras formation. Several quartz veins 1 inch to 6 inches thick cut the chert. These veins run more or less parallel to each other, and have a general trend of N. 55° W., and a dip of 20° to 25° SW. The attitude of the chert could not be determined. The quartz veins contain vugs with crystals up to an inch long and a quarter to half an inch thick. Thin films of manganese oxide occur along fractures in some of the quartz veins, but most of the manganese is in the chert, and not in the quartz.

The manganese oxide occurs in pockets scattered at several horizons from the top to bottom of the shaft. The largest pocket seen was 1 foot in diameter, located near the bottom of the shaft on the northeast wall.

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[2] California Min. Bur. Bull. 76, p. 52, 1918.

Most of the pockets are only a few inches thick. Much of the ore is soft, sooty, black, somewhat porous pyrolusite. Some is blue-black, massive hard psilomelane with a conchoidal fracture. A hard gray crystalline mineral was seen, which may be manganite. No unoxidized manganese minerals were observed; however, similar appearing deposits in this general area are derived from rhodonite. The main impurities in the ore are patches of yellow to white chert and quartz vein material. Some specimens on the dump appear to be fairly high grade—running perhaps 45 to 50 percent manganese, although the average of the dump is probably closer to 35 or 40 percent.

The extent of the manganese ore could not be determined, as it was not seen outside of the shaft. Two small pits, one northwest and one southeast, expose massive chert with very little manganese. Another cut to the southeast reveals only slate or phyllite. No production is recorded from this property.

No. 6. Randel Claim No. 1 (American, Tilsley and Coplen Claim). (By Ivan F. Wilson, August 11, 1942.) The Randel claim No. 1 is in the same location as the American claim of the Tilsley and Coplen group of World War I.[3] It lies in the SW$\frac{1}{4}$ sec. 20, T. 14 N., R. 10 E., 2 miles along the road north of Yankee Jims. The workings are found in two places on a steep southerly slope: (1) about 400 feet uphill above the road, and (2) immediately below the road. One ore-bearing bed crosses the road about 200 feet west of a gully around which the road bends. This gully is a tributary to Mexican Gulch, which lies south and west of the claim. The hill slope here is covered with a thick growth of manzanita. The nearest shipping point is 9 miles northwest at Colfax, on the Southern Pacific Railroad. The Randel No. 1 was located February 23, 1941, by E. V. Delmue of Yankee Jims. The long direction as stated on the claim notice is north. No development has been done since World War I.

The ore occurs in pockets 6 to 12 inches in diameter, in beds of metachert. The chert is metamorphosed to fine-grained gray quartzite or greenish-gray cherty slate. The metachert contains stains, stringers, and pockets and lenses of manganese oxides. The manganiferous metachert is enclosed in gray to yellow sericite schist or phyllite, which has been mapped as Calaveras formation. The rocks strike north to N. 25° W., and dip 60° to 80° E. Both the metachert and manganese oxides are cut by gently dipping quartz veins from a fraction of an inch to 6 inches thick. The quartz veins are generally confined to the zone of metachert, even though they cross it at an angle. This relationship is well exposed where the metachert crosses the road between the lower and upper workings. A prominent quartz vein 6 to 8 inches wide crosses the metachert, inclined 30° E., but stops abruptly at the contact with the schist on each side.

The main bed in the upper workings is exposed over a total length of 90 feet and in the lower workings for 265 feet. However, beyond 190 feet the latter carries very little manganese except for stains. The ore is a mixture of psilomelane and pyrolusite, containing admixtures of quartz vein material and metachert. Some of the higher-grade ore that occurs in pockets and lenses probably runs 40 to 45 percent manganese. The average probably is closer to 20 percent. Some specimens containing patches of pink rhodonite were noticed on a dump south of the road.

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[3] California Min. Bur. Bull. 76, p. 52, 1918.

During World War I the Tilsley and Coplen group, together with the Crown Point claim, are said to have produced 100 tons of ore running 45 percent manganese and 15 percent silica. On the dumps are 5 to 10 tons of ore containing about 40 percent manganese.

No. 7. Yankee Jims (Lee?) Deposit. (From files of U. S. Geological Survey, 1918.) The Yankee Jims deposit is said to be owned by D. W. Lee. It may be the same deposit as the Lee Prospect.[4] The deposit is believed to be located 12 miles northeast of Auburn near Yankee Jims, probably in T. 14 N., R. 10 E. The ore body is in a small bed and has not been developed. An assay of the oxide ore gives 40 percent manganese and 20 percent silica.

PLUMAS COUNTY

No. 1. Banner, Barrington, and Crabtree Deposit. (From files of U. S. Geological Survey, 1942.) A deposit in Plumas County, said to be owned by Messrs. Banner, Barrington, and Crabtree, according to the records of the Metals Reserve Company, produced 8 tons of low-grade B ore containing 35 to 40 percent manganese, in 1942. No information as to the location of the deposit is available.

No. 2. Braito Mine (Dixie Creek, Feather River, Iron Dyke). (By N. L. Taliaferro, 1918.) The Braito manganese mine is about 3 miles southwest of Crescent Mills. To reach the deposit, one turns off the main Crescent Mills-Indian Falls road at Dixie Creek and follows a good wagon road three-quarters of a mile. From this point a road is being built to the mine. The deposit is located on a very steep southeast-sloping hill northwest of Indian Creek, and is at an elevation of 5,050 feet, about 1,500 feet above the creek. The slope of the mountain side is about 33°. This deposit is 4 miles northwest of Mount Hough. The claim on which the deposit is located is in sec. 27, T. 26 N., R. 9 E. It is owned by Mr. Mason of Indian Falls, and is leased by the Noble Electric Company. Mr. E. J. Cary is in charge of the work.

This deposit occurs in the same formation as that of Mount Hough, the Arlington formation, and is at about the same horizon. A narrow belt of meta-andesite (Taylor meta-andesite?) is 225 feet northeast of the deposit. The deposit is similar to the Crystal Lake (Plumas 5) deposit on Mount Hough. It is associated with a red chert lens interbedded with slate and quartz sericite schist. Exposures were not sufficient to determine the relation of the manganese ore and the chert; that is, whether or not the deposit is parallel to the bedding of the chert. Because of the heavy mantle of waste covering the steep hill slope, a continuous section could not be obtained. The general strike of the rock is N. 40°-40° W., and the dip, 50° to 55° SW.

At the time that the deposit was first visited in August 1917, the only development consisted of several open cuts and a 57-foot tunnel. Since that time 1,000 tons of ore has been shipped. The tunnel runs N. 62° W., nearly parallel to the strike, and is in slate and schist, except at the end, where chert is exposed. In the upper left corner of the tunnel, manganese ore has been exposed to a depth of 3 or 4 inches. Most of the open cuts along the vein are above the tunnel, and in these the vein is from 4 to 5 feet in width, and is continuous for at least 60 feet. Float of black manganese ore is found for some distance up the hill above the uppermost open cut. The lower open cuts have not reached rock in place. They have uncovered several very large blocks of manganese float, but about 30 tons of ore has been obtained in this way, with fully as much ore in sight. At least 70 tons of ore has been mined. The ore is slightly more siliceous than that on Mount Hough. It is said to run from 44 to 51 percent manganese, and from 9 to 18 percent silica.

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[4] Logan, C. A., Placer County: California Min. Bur. Rept. 23, p. 283, 1927.

The ore consists of rather hard massive psilomelane with some soft pyrolusite. One piece of float was found which on the outside was lustrous jet black with an unoxidized vein of pink rhodonite showing on one surface. When broken this specimen showed a core of partly unoxidized material, gray to pink in color. Under the microscope this core material is seen to be made up of a fine-grained aggregate of rhodonite and albite, the component grains being anhedral and averaging less than 0.02 millimeter in diameter. The rhodonite predominates. Veins of rhodonite are fairly numerous and are apparently more resistant to oxidation than the granular rhodonite of the rock. Whether or not the entire deposit is due to the oxidation of this type of rock is not known, as the only ore found in place was thoroughly oxidized, no trace of the original material being left. This granular aggregate of rhodonite and albite indicates a vein rather than a bedded deposit as the origin of the ore.

This deposit was worked extensively in World War II and produced considerable ore. The ore mineral was chiefly braunite. (P. D. T.)

No. 3. Burch and Woody Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 53, 1918.) The Burch and Woody prospect is near the line of secs. 21 and 28, T. 26 N., R. 9 E., 4 miles west of Crescent Mills. The owner is A. Burch. When the property was visited a small amount of manganese oxide, too siliceous to sell, had been taken out.

No. 4. Cannon Prospect. (By J. M. Nelson, July 1941.) The Cannon deposit is 5 miles south of Crescent Mills in the NW¼ sec. 6, T. 25 N., R. 10 E. It is 3 miles from the railroad and 2 miles from a road. The prospect is owned by F. W. Bradley and A. C. Wear. The deposit is located on a steep slope; it strikes northwest and dips steeply southwest. A substantial amount of manganese silicate is present, but relatively little oxide. A short adit has been driven into the hill at right angles to the strike of the ore bed, but most of the ore material is high in silica. No ore has been shipped.

No. 5. Crystal Lake Mine (Mount Hough, Myton and Kloppenberg). (By N. L. Taliaferro, August 1917.) The manganese deposit covered by the Crystal Lake claims extends from the summit of Mount Hough to the northwest for half a mile or more. The claims are owned by H. Kloppenberg, R. L. Kloppenberg, and H. S. Myton of Quincy. At present they are leased by W. S. Robinson of Quincy and J. W. Plant and G. K. Allen of San Francisco, who are building a road from the deposit around the south side of Mount Hough to the Quincy road, a distance of about 1 mile. The claims are in sec. 8, T. 25 N., R. 10 E.

At the time the prospect was visited, the only development consisted of four shallow trenches dug through the surface soil to the manganese vein or bed. As shown by the trenches, the strike of the vein is N. 45° W., the dip 60° to 70° SW. The bed or vein is parallel to the bedding of the chert. It averages 6 feet in width. The ore appears to be mostly psilomelane with some pyrolusite and the earthy mixture of oxides known as wad. An average sample of the ore is said to have run 48.6 percent manganese and 5.5 percent silica. The vein is confined to the red chert and probably represents the oxidation of a bed or vein of manganese carbonate or silicate.

The chert is dark red hard dense and has an uneven to conchoidal fracture. Numerous small patches and veinlets of black manganese oxide are in the chert. Small patches and veinlets of quartz can also be distinguished. The surface of the rock and the cracks through it are covered with blue-black manganese films in many places.

Under the microscope the rock is seen to be composed of red iron oxide dull cloudy amorphous or cryptocrystalline silica, quartz, and black manganese oxide. The amorphous silica is generally deeply stained with red iron oxide and occurs as fragments and patches in a very irregular network. This makes up about 55 percent of the rock. The manganese oxide is found in the patches of red iron oxide as irregular aggregates or veinlets. The quartz is in small grains and aggregates of grains. The individual grains range in size from less than 0.01 to 0.14 millimeter. The average size is between 0.01 and 0.02 millimeter. The rock has the appearance of having been brecciated and then impregnated with silica in the form of quartz. A specimen taken from the hanging wall of the vein shows that movement has taken place. The chert is cut by broken quartz veins as much as half an inch in width and by brecciated stringers of manganese ore. Some secondary calcite is present. The ore exposed in the trenches seems to be fairly solid, and veins of quartz are rare.

About 125 feet northwest of one of the trenches, the vein is exposed at the top of a very steep slope. Here the vein is wider but much more siliceous than in any of the trenches, and both the ore and red chert are veined with quartz. The manganese ore has split into several veins separated by red chert. An average sample is said to have run 28 percent manganese and 32 percent silica. However, some good ore could be obtained by hand sorting.

The following was made at this locality, going southwest across the strike, up in sequence:

	Thickness (feet)
Slate	300
Red chert	75
Quartz, sericite schist (may represent an altered tuff)	20
Red chert	15
Manganese-bearing chert and black manganese ore, veined with quartz	12
Quartz-sericite schist and slate	100

Some manganese ore seems to be present in the 75 feet of red chert, as float of black manganese oxide was found on the surface along this belt. The quartz-sericite schist and slate appear to be faulted against the chert. The fault has a small displacement.

The vein is again exposed a few yards south of the lookout on the summit of Mount Hough. Some good ore might be obtained here by hand sorting. A section is as follows:

	Thickness (feet)
Red chert	less than 50
Quartz-sericite schist	20–25
Chert veined with manganese and quartz	15–20

Subsequent to Taliaferro's visit in August 1917, the Crystal Lake deposit produced over 1,000 tons of ore. It was not operated in World War II, having been largely depleted of readily available ore.

No. 6. Dickie Bird Deposit. (By J. M. Nelson, July 1941.) The Dickie Bird deposit is located near the bottom of a creek, 6 miles west of Crescent Mills in sec. 28, T. 26 N., R. 9 E. It is said to be owned by a timber company and leased to M. M. and B. J. Burdick. The ore body strikes northwest and dips nearly vertically. The deposit is reported to have produced 35 tons in 1917, averaging 37 percent manganese and 18 percent silica. Development consists of an adit and a drift along the ore zone. The primary ore is mainly rhodonite and bementite, which seemingly occurs in pods. Relatively little oxide ore is present. The average grade of the oxide is estimated to be 25 percent.

No. 7. Iron Queen Deposit. (By J. M. Nelson, July 1941.) The Iron Queen deposit is 5 miles west of Greenville in secs. 7 and 8, T. 26 N., R. 9 E. It is owned by A. F. Smith and C. DeVelter of Greenville. Prior to World War I the deposit was worked for gold, and a few tons of manganese oxide and manganese silicate were thrown on the dump. The workings are now caved. The ore body strikes northwest and dips nearly vertically. As indicated by the material on the dump, the grade of manganese is low and relatively little oxide is likely to be present. The deposit has produced no ore.

No. 8. Liberty Prospect. (By N. L. Taliaferro, September 1918.) The Liberty deposit is 9 miles north of the Western Pacific Railroad at Quincy Junction in secs. 14 and 15, T. 25 N., R. 10 E. It is owned by James Shaw of Taylorsville. The deposit is a low-grade bedded manganese silicate, estimated to contain about 15 percent manganese. The ore body is exposed for 60 feet and averages 1 foot in thickness. It has not been developed.

No. 9. Lost Soldier Deposit. (By J. M. Nelson, July 1941.) The Lost Soldier deposit is 5 miles southwest of Taylorsville in the NW$\frac{1}{4}$ sec. 6, T. 25 N., R. 10 E. It is 2 miles from a road and 3 miles from the railroad. The owners are Frank Bear, J. L. Groves, C. A. Asham, and A. M. Barton. The deposit is close to the Cannon prospect (Plumas 4) and is a similar type of ore body. The primary minerals are bementite and rhodonite. Relatively little oxide is present. The average grade of the oxide ore is estimated to be 20 percent manganese. Development consists of four open cuts, but no ore has been produced.

No. 10. Penrose Lode. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 54, 1918.) The Penrose lode is located on Mumford Hill, 3 miles southwest of Meadow Valley, near Edmanton, in T. 24 N., R. 8 E. Manganese occurs as oxide in the gossan of a quartz vein, similar to that at the Diadem lode (Plumas 12). The deposit is probably superficial. It is owned by the Edman Estate of Quincy.

No. 11. Rush Creek Prospect. (From files of U. S. Geological Survey, 1941.) The Rush Creek deposit is owned by C. W. Rymer of Quincy. Its location is unknown. An assay of 17.4 percent manganese is quoted. No ore has been produced.

No. 12. Sierra Manganese (Diadem Lode) Deposit. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 53, 1918.) The Diadem lode is one of a group of three claims which include 20 acres, in the Edmanton district. The property is 14 miles southwest from Quincy in sec. 33, T. 24 N., R. 8 E., and is owned by Edman Estate of Quincy. Manganese oxide and rhodonite occur in a quartz vein associated with iron oxide. The vein strikes N. 37° W., and dips 60° NE. The prospect has not been developed. It probably is only a superficial deposit.

No. 13. Sunset Prospect. (By J. M. Nelson, July 1941.) The Sunset deposit is 5 miles south of Almanor in the SW¼ sec. 3, T. 26 N., R. 8 E. It is owned by W. J. McMillan and A. E. Williamson. The deposit is similar to the other small silicate deposits in this region. Relatively little oxide ore is present and no ore has been produced. Development consists of a few shallow pits and trenches. The better grade of oxide ore is estimated to contain 30 percent manganese.

No. 14. Valley View Deposit (Lake View, Mustang, Chrome Iron, Crescent Mills). (By J. M. Nelson, July 1941.) The Valley View deposit is 5 miles west of Crescent Mills in sec. 27, T. 26 N., R. 9 E. The ownership is contested. This deposit is situated half a mile from a road and is not now being worked. In 1917 it was explored by several adits and trenches, which are now caved. A production of 42 tons in 1917 is reported, the grade ranging from 40 to 56 percent manganese and from 2.5 to 12 percent silica. The ore body is a steeply dipping bed containing manganese silicates. Relatively little oxide is now visible.

No. 15. West and Shaw Prospect. (By N. L. Taliaferro, September 1918.) The West and Shaw deposit is 6 miles northeast of Taylorsville in secs. 26 and 27, T. 26 N., R. 11 E. It is owned by N. West and J. Shaw of Taylorsville. The property has not been developed. The ore body is a bedded deposit, which contains some high-grade ore. One assay gives 50 percent manganese, 1 percent iron, and 2 percent silica. However, ore of this grade is not likely to be found at depth, as most of the primary minerals in this general region are manganese silicates.

RIVERSIDE COUNTY

No. 1. Arlington (Ironwood) District. (Black Horse Group, Blackjack, Bray, Groce, Kenzie, Melvin, Melville Gross, Parsons, Red Rock, Schellenger, and Social Deposits.) (By Parker D. Trask, August 11, 1942.) The Arlington or Ironwood district is located in secs. 13 and 24, T. 4 S., R. 19 E., and sec. 19, T. 4 S., R. 20 E., 30 miles northwest of Blythe, and 12 miles west of Inca, the nearest shipping point. The deposits are owned by Fred Kroger of Pomona, and are now being operated by A. B. Miner, Culver City. They were operated by several different organizations as distinct properties during World War I, and 300 people are reported to have been engaged in mining. In all, 5,000 tons of oxide ore averaging 42 percent manganese was produced then. During World War II about 1,000 tons of ore containing approximately 24 percent manganese was shipped to the Kaiser plant at Fontana, prior to March 1943.

The deposits are at the north end of the McCoy Mountains on the edge of a bajada. The country rock consists of volcanic flows and fragmental rocks. These are cut by fissures that trend approximately north and dip steeply west. In places the volcanic rocks are brecciated for a short distance on the sides of the fissures. Several sets of fissures are present, one of which extends for 4,000 feet across the country. At least two shafts have been sunk to a depth of 100 feet along fissures. Drifts

100 feet in length have been driven in individual levels. The ore is found in shoots up to 400 feet in length and 5 feet in width. The average grade of the ore on the walls of the stopes and in the better ore shoots is about 20 percent. About 3,000 tons of ore, estimated to contain 20 percent manganese is in dumps and perhaps 500 tons is in gravel wash in streams that run past the dumps.

Blackjack Mine. (By F. S. Hudson, October 9, 1918.) The Blackjack mine is located near the north end of the Ironwood or McCoy Mountains, Riverside County, about 10 miles by road west of Brown Siding on the California Southern Railroad. The property was originally located by E. E. Schellenger of Blythe. It was sold by him to C. F. Bradford, who worked it during part of 1917. At the time of the writer's visit to the property in November 1917, the work was being done by the Blythe Branch of the Peoples Trust and Savings Bank of Riverside, which held it in trust pending decision of the courts as to ownership in a suit brought by Schellenger against Bradford. This suit was decided in Schellenger's favor but the bank is still interested in the mine. About 800 tons was shipped from March 1, 1918, to October 1, 1918, at the rate of about 120 tons per month. Five men were at work on the day of visit.

The ore occurs as lenses along a vein which strikes N. 15° W., and dips 55° W. The most productive of these lenses extends 50 feet along the strike, 45 feet along the dip, and has a maximum thickness of 8 feet and an average thickness of 4 feet. The country rock is quartz porphyry which is bleached to a dull white at many places adjacent to the vein.

The vein has been followed for 130 feet by a tunnel trending S. 15° E. At 30 feet from the mouth of the tunnel an incline has been sunk along the dip to a vertical depth below the tunnel of 70 feet. At 35 feet below the tunnel level, drifts have been opened 45 feet to both north and south. At the bottom of the incline a drift is being run to the south. The vein has been stoped to a height of 10 to 30 feet above the tunnel at 75 feet from the mouth of the tunnel. A continuation of this stope goes 20 feet below the tunnel from 60 to 76 feet from the mouth of the tunnel. The ore has been stoped to a height of 15 feet for 20 feet along the north drift which is 35 feet below the tunnel.

All the ore above the tunnel level has been removed. The faces of both drifts at 35 feet below the tunnel show less than 1 foot of ore, but further drifting in each direction may find more good ore. The face of the drift from the bottom of the incline shows 2 feet of good ore. Ore was being taken from this face at the rate of about 2 tons per day. No ore is in sight in the mine, nor can any estimate of probable ore be given. However, the possibilities of finding considerably more ore here are very good.

The dump of this mine contains a large amount of material that should be amenable to concentration. The larger pieces are composed of fragments of decomposed porphyry in a matrix of high-grade psilomelane. The eastern end of the dump, containing about 1,000 tons, carries much more manganese than does the western end. A Mr. Sabadie has obtained a lease on the dump and is screening the material through a quarter-inch screen. According to the foreman he is saving the fines and rejecting the oversize. Samples were taken of this material. The results of assay follow. Sample of 1,000-ton dump: manganese, 32.7 percent; insoluble, 27.3 percent. Sample of fines from screening: manganese, 18.5 percent; insoluble, 43.8 percent.

Evidently this process of concentration works in the opposite direction to that which the foreman claimed. The oversize is richer than the screenings. In order that this oversize be a commercial product the proportion of heads to tailings (screenings) must be smaller than 3:1. It is the writer's opinion that 3 tons of the dump material contains considerably less than 1 ton of minus a quarter-inch size. However, it is apparent that some concentration can be effected by sizing this type of ore. This is worthy of note as similar tests on Coast Range ores have given little or no change in manganese content in the various sizes.

Bray Mine. (By R. R. Morse, October 8, 1918.) The mine locally known as the Bray property is operated by P. H. Bray and James Trembath, who are purchasing it on a lease and bond basis from C. E. Groce, the original locator of this and several adjacent claims. Royalty of $3.00 per ton is paid by the operators, this sum being applied on the purchase price for the mine. It is located near the south end of the Ironwood district, in the upper reaches of the canyon in which are also located the Groce and Parsons mines. The distance by road to Brown Siding on the California Southern Railroad is 11 miles. The present rate of shipment from the mine is approximately two cars per month. Up to the end of the first week in October, 800 tons (16 cars) had been shipped. Of these, nine cars were shipped to the Western Ore Purchasing Company, one car to Lewellyn Iron Works at Torrence, and the remaining six cars to various buyers. The last car shipped is said to have run manganese, 46 percent; silica, 1.98 percent.

The ore occurs in well defined veins cutting quartz porphyry. It consists of massive psilomelane, generally showing a submetallic to bright metallic luster, a pronounced tendency to concentric structures, and much black sooty amorphous oxide occurring as minute bands or layers alternating with the massive facies of ore. Considerable gangue material occurs in the ore, making necessary a very careful hand sorting of all ore before shipment. The gangue consists of finely disseminated gypsum, and coarser nodules or irregular lumps of gypsum, together with a varying proportion of more or less unreplaced country rock, which occurs as small blocks or "horses" within the ore zone. Furthermore, a certain amount of soft bleached porphyry of the walls is unavoidably mixed with the ore in the mining.

The vein has been opened by a 46-foot shaft, from the bottom of which drifts extend for a distance of 100 feet N. 8° E., and a distance of 80 feet S. 8° W. (magnetic). Through this shaft a hoist is operated by a 6 horsepower Fairbanks Morse crude oil engine. A considerable amount of stoping has been done from the drifts to the surface. In the stopes the width of the vein has varied between 3 and 9 feet. The walls are everywhere sharp between the massive vein filling. The country rock is sheared and bleached porphyry.

In the breast of the south drift the vein is sharply cut by a fault trending N. 50° W., and dipping 50° S. The amount of throw of this fault cannot be determined until further development has been completed. In the breast of the north drift, solid ore is continuing, although the vein has narrowed to a width of 2.5 to 3 feet.

Groce Mine. (By R. R. Morse and F. S. Hudson, October 8, 1918.) C. E. Groce of Blythe is working three manganese veins situated in the northern part of the McCoy or Ironwood Mountains on the north side of the canyon, directly opposite Parsons mine. The distance by road from this property to Brown Siding on the California Southern Railroad is 10 miles. No shipments have been made yet, but the first car should be shipped in November 1918. At the westernmost vein a 15-foot shaft has been sunk on the vein, which strikes N. 25° E., and dips 75° W. The vein carries from 4 to 8 inches of high-grade ore and shows sharp contacts against the quartz porphyry country rock. Further prospecting seems advisable on this vein but it should be in the form of surface trenching rather than more underground work.

One hundred and fifty yards northeast of the last mentioned place. a 28-foot incline has been sunk along an ore zone which consists of a system of narrow stringers of black oxide ore cutting bleached quartz porphyry. About 20 tons of good ore has been recovered here by mining and sorting 100 tons of rock. No further underground work seems advisable but prospecting along the strike of the ore zone at the surface may yield good results.

Fifty yards east of the last locality a 50-foot tunnel has been driven along a vein, which strikes N. 30° W., and dips 70° W. An average of 16 inches of ore is seen in the roof for the entire length of the tunnel, and 18 inches of ore is exposed in the face of the tunnel. The vein is composed of black oxides carrying blocks of bleached quartz porphyry. About one-third of the vein is waste rock. No stoping has yet been done.

Parsons Mine. (By R. R. Morse and F. S. Hudson, October 8. 1918.) The Parsons mine is owned and operated by H. M. Parsons of South Pasadena. Z. B. Drum of Oakland is the superintendent. It was formerly owned by C. E. Groce, and was described in a previous report as the Melvin mine. The mine is in a canyon 0.3 mile south of the Blackjack mine, in the northern part of the McCoy or Ironwood Mountains. According to Mr. Groce, six cars were shipped by him from November 1917 to April 1918 when the mine passed into Mr. Parsons' hands. From that time to October 8, 1918, six or seven more cars were shipped. The total production to date is thus about 500 tons.

The ore occurs as a vein of psilomelane, pyrolusite, calcite, and rock fragments, and cuts quartz porphyry. The strike is N. 5° W., and the dip 65° W. An incline follows down 100 feet along the vein. At a depth of 25 feet drifts run 40 feet north and 65 feet south from the incline. At a depth of 50 feet, a drift goes 50 feet south from the incline. At a depth of 100 feet, a drift has been run 30 feet to the south. The ore has been stoped from the 50-foot to 20-foot level for 50 feet south from the incline. The face of the south drift on the 25-foot level shows 2.5 feet of ore. The face of the north drift on the same level shows 1 foot of ore. The faces of both north and south drifts on the 50-foot level expose only a few inches of ore, of doubtful grade. The face of the south drift on the 100-foot level shows a few inches of poor ore. Dee Clark, foreman, thinks that the ore shoot rakes to the south, and that the south drift from bottom of incline will find ore of workable width within a short distance. It is good prospecting to drive at least 20 feet farther on the 100-foot level.

Red Rock Mine. (By R. R. Morse, October 9, 1918.) The property locally known as the Red Rock mine is in the southern end of the Ironwood district, the chief workings being 5 miles by road south of the Bray and Melvin camps, at the eastern foot of the range. The distance by road to Brown Siding on the California Southern Railroad is 14 miles. The claims are owned by E. E. Schellenger of Blythe, and are being operated under lease by Dee Clark of Blythe. One car of ore has been shipped to date.

The ore occurs in three narrow veins cutting quartz porphyry, called the east, middle, and west veins. In the east vein, 1 foot to 1.5 feet in width has been exposed by trenching along the outcrop of this vein for a distance of 115 feet. Vein material is exposed, however, up to widths of 4 feet at various places along this distance. It consists of an intimate mixture of psilomelane, calcite, and leached, porous, more or less unreplaced porphyry. This material is too low in grade to be shipped direct, and the mixture is so intimate that sorting to shipping grade is out of the question. The vein trends N. 35° W., and dips vertically, cutting across the major direction of jointing in the porphyry. This jointing, or sheeting, is so well developed in the region as to give the porphyry a definite schistose structure which is especially prominent in the vicinity of the ore outcrops. The average trend of this sheeting is N. 15° E., and the dip is 35° W.

An 18-foot shaft has been sunk. At the surface this vein extends N. 12° W. for a distance of 75 feet from the shaft, beyond which point, it fingers out, small veinlets of ore ramifying into the shearing planes of the porphyry. The width varies between 6 and 14 inches, but the ore is everywhere badly mixed with gangue and wall rock. Small irregular shoots or bunches of high-grade shipping ore occur here and there, but as a whole the vein matter requires sorting to a point beyond economical operation at the present time.

The west vein lies a few rods west of the middle vein. Two open cuts expose a zone of badly mixed ore, resting against a wall of slickensided leached porphyry. In the first cut the vein matter is 3 feet wide at the surface, rapidly wedging out downward, and is truncated by a slip in the bottom of the cut. In the second cut, a few feet north of the first cut, the vein shows 3 feet of low-grade mixed ore. The ratio of calcite gangue and partly replaced altered siliceous porphyry to high-grade shipping ore is too high to allow the material to be marketed without concentration. Between 25 and 50 tons of ore is in sight here.

About 100 yards northeast of the workings on the other veins occurs an outcrop of a small veinlet 25 or 30 feet long and a few inches wide. Work was about to begin on this stringer at the time of the visit to the property. A few tons of high-grade ore are in sight. The extremely narrow width of the exposure does not suggest the presence of a commercial body of ore. The ore is, however, the best quality of any of the exposures on the claims.

Social Manganese Mine. (By F. S. Hudson, October 8, 1918.) The Social property is situated at the north end of the McCoy Mountains half a mile due west of the Blackjack mine. It is owned by Floyd Brown and is operated under lease and bond by G. T. Nichols, of Los Angeles. The best showing on the property is a vein that can be traced several hundred feet along the strike which is north, and for over 50 feet along the dip which is 75° W. Stripping at one place proves a width of 16 inches of clean ore. A tunnel that is being driven from the north underneath this place shows 1 foot of clean ore. The country rock is quartz porphyry bleached to a dull white for some distance on each side of the vein.

No. 2. Beal-McClellan Property (Elsinore, Newport, Brum, and Newport Black Eagle). (By Ivan F. Wilson, October 25, 1942.) The Beal-McClellan property is between Elsinore and Perris in the SW¼ sec.

23, T. 5 S., R. 4 W. It is reached by proceeding northeast of Elsinore toward Perris for 6.5 miles, then turning off to the southeast for an additional 2.3 miles via dirt road past Mills Bee Ranch. The mine is on the crest and southeast slope of a ridge located just northwest of Railroad Canyon Reservoir. The nearest shipping point is 8.8 miles away, at Elsinore. The owners of the property are G. S. Beal and R. W. McClellan. It is understood that G. R. Smith of La Habra, also has an interest in the property. A five year lease was given August 26, 1942, to A. P. Manion, of Perris.

This mine is old, but the present owners were unable to give any information about its past history. The location and description of this property correspond closely with the Newport, or Brum and Newport claim, as listed in the card files from the 1918 investigation. In Bulletin 76,[1] however, the description and location correspond better with the Elsinore manganese deposits than with the Brum and Newport claim as described in that Bulletin. It is possible that the Brum and Newport and the "Elsinore" properties as described in Bulletin 76 are the same properties. A production of 50 tons is listed from the Brum and Newport claim. The 1941 production is said to be 30 tons.

Development consists of a series of open cuts, stopes, and drifts extending from the top of the ridge down the southeast slope for a distance of 125 feet. The lowest drift extends 35 feet southeast, then 60 feet N. 35° W. This drift is connected to the southwest by a 15-foot crosscut extending to the bottom of a shaft. An upper drift and stope go 25 feet northwest of the shaft, and this is connected with the lower drift by an inclined tunnel. A caved open cut is 50 feet farther down the slope from the lower drift, but this now exposes no manganese ore.

The manganese ore at this property is a bedded deposit occurring in a slightly metamorphosed white to gray chert. The wall rock has a typical cherty appearance to the naked eye, but with a lens it may be seen to be finely recrystallized. The chert occurs in beds 1 inch to 4 inches thick, associated with slaty shale layers. The surrounding rocks are chiefly slate. The rocks of this area are mapped on the State Geologic Map [2] as Triassic metasediments. The chert and manganese ore bed, which are parallel, strike N. 60°-80° W., and dip 50° to 65° NE.

In the main stope the ore bed is offset by 2 or 3 cross faults with displacements up to 4 feet. These faults strike N. 45° E., and dip northwest. The manganese ore bed is 1 foot to 2 feet thick, and crops out for a distance of 125 feet. It is exposed to a depth of 20 feet from the surface. It consists of partly to completely oxidized rhodonite, which in places has given rise to fairly good black oxide ore, estimated to run between 35 and 40 percent manganese. Some of the rhodonite is in prismatic crystals 0.2 inch long. A few specimens show a brown resinous opaline material, which may be neotocite or bementite, and some specimens also contain light brown crystalline garnet (?). In some places the rhodonite extends to the surface; elsewhere a considerable amount of oxide ore has been developed.

The most unfavorable factor at this property is the presence of rhodonite. Some oxide ore has been shipped from the mine, however, and it seems likely that more may be obtained. About 5 tons mostly of oxide ore was on the dumps when visited by the writer. A sample from the dump, collected by the writer, ran 30.87 percent manganese. It is difficult to estimate what proportion of this tonnage will be oxide ore, but it seems doubtful to the writer if more than 100 tons additional oxide ore could be expected from the ore bed, which is at present developed.

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[1] California Min. Bur. Bull. 76, pp. 56-57, 94, 1918.
[2] California state geologic map, scale 1:500,000: California Div. Mines, 1938.

No. 3. Box Canyon (Shaver Well) Prospect. From files of U. S. Geological Survey, 1942.) The Box Canyon or Shaver Well prospect is 6 miles northeast of Mecca, probably in sec. 24, T. 6 S., R. 10 E. It is said to be owned by Lelon Noblitt of Brawley. No other information is available.

No. 4. Clark and Losekamp Prospect. (From files of U. S. Geological Survey.) The Clark and Losekamp prospect is 4 miles southeast of Winchester in the southwest part of T. 5 S., R. 1 W. It is said to be owned by L. R. Clark of Riverside. It is undeveloped and is reported to consist of manganese oxide in bedded rocks.

No. 5. Doran Manganese Claims. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 57, 1918.) The Doran property is in the north end of the Palen Mountains, probably in sec. 19, T. 4 S., R 18 E., 10 miles northwest of the Blackjack mine (Riverside 1), and 22 miles northwest of Mineral. Packards Well is 6 miles to the north. The owner is W. C. Doran. The locations comprise two claims extending end to end in a general northerly direction. These claims embrace the top of the ridge, whose altitude at the point of discovery is 2,500 feet above sea level, and 700 feet above the wash at its base. The road from Mineral to Adams Well is probably 3 miles in an air line west of the property. From this point the property is accessible only by a rugged desert trail.

The manganese occurrence here is very similar to that of the McCoy Mountains (Riverside 1), the ore being deposited in a vein, which fills a fault fracture in rhyolite. The outcrop is first observed 300 feet below the summit, striking a little east of south. Here it has a width of several feet but is intermixed with the brecciated rhyolite. A small cut shows about 18 inches of high-grade ore. The vein can be followed over the summit and down the south slope for several hundred feet. At the few places where cuts have been made, it appears to be widening with depth. About 50 feet east of the main vein, a series of outcrops were observed which evidently mark a parallel vein. Ore from these claims assayed 44 percent manganese, and 3.9 percent silica. The locations were made in 1915, but owing to their inaccessibility have never been developed. Considerable work must be done before it can be determined whether the veins will yield a sufficient tonnage to warrant the expense of constructing a road to the property.

No. 6. Elsinore Manganese Deposits. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 58, 1918.) The Elsinore deposits, long known and located, are 6 miles northeast of Elsinore, in secs. 23 and 24, T. 5 S., R. 4 W. They are owned by Charles P. Carter. One group of six locations is west of the Santa Fe Railroad, and another group of nine locations is east of the railroad, and perhaps half a mile farther north. The principal vein is in sec. 23. This vein crops out at the top of a hill, 1,500 to 2,000 feet distant from, and 400 to 500 feet above, the railroad. The outcrop here is 3 feet wide, and a hole 3 feet deep has been sunk upon it. Some 75 to 100 feet distant, toward the railroad, a 10-foot shaft has been sunk, showing the vein to be 4 feet wide at the surface. Below this point is a tunnel 20 feet in length, driven in the footwall, so the width of the vein is undeterminable. The central vein seemingly is 16 to 20 feet in width. It is considerably broken and covered with detritus.

No. 7. Giant Chief Claim (Manganese Extension). (By Ivan F. Wilson, March 24, 1943.) The Giant Chief claim is 0.3 mile south of the Paddy Faulkner claim (Riverside 10). It is 14 miles by road south of Rice, 1.5 miles west of the Rice to Blythe road, and 5 miles northwest of Midland, a station on the Santa Fe Railroad. The claim is probably in the eastern part of sec. 3, T. 5 S., R. 20 E. It is situated on a low knoll 15 feet high and 150 feet long completely surrounded by an alluvial plain. The ownership of the claim is disputed. It is claimed as the ''Giant Chief'' by Solomon Ally of Parker Dam; Paul Duecker of Beuss, Arizona; and a Miss Daisy of Rice. The date of this location is unknown. A conflicting notice dated August 1, 1941, by C. M. Houser of Los Angeles, and Charles McLaughlan, claims the property as ''Manganese Extension.'' There has been no production, and the property was idle when visited. The only development on the property is an open cut 10 by 4 feet, and 6 feet deep.

The deposit is of the same type as the Paddy Faulkner (Riverside 10), and the Langdon (Riverside 8) but is even smaller than the Paddy Faulkner. It consists of irregular pockets and small stringers of manganese oxide in a finely crystalline, buff to pinkish limestone, underlain by thin-bedded micaceous quartzite. The limestone strikes east and dips 20° N. No pockets of ore are over 1 foot thick, and no body is large enough to mine. Assays of 29 to 32 percent manganese are quoted. The possibilities for large reserves are poor, inasmuch as the limestone body itself is exposed for a length of only about 100 feet before being buried by alluvium; and the manganese oxide pockets make up only a small part of the limestone.

No. 8. Langdon Deposit (Dioxide Group, Mabery and Brown, Arentz-Perkins, Hauser-Martin-Cheeseborough). (By Ivan F. Wilson, March 15, 1943.) The Langdon deposit is on the east flank of the Little Maria Mountains in sec. 8, T. 4 S., R. 21 E. It is 3 miles by road west of Cox Siding on the Santa Fe Railroad (Blythe Branch), and is 23 miles by road northwest of Blythe. The deposit is owned by C. M. Langdon, except for the northern part which is on the property of the U. S. Gypsum Corporation. The property has been leased to Francis Gage. During World War I the southeastern part of the Langdon deposit was known as the Dioxide group, owned by Mabery and Brown; and the northwestern part was known as the Arentz-Perkins and also as the Hauser-Martin-Cheeseborough property. The production from this group of deposits is uncertain, but is said to be 1,500 tons. Of this amount, about 1,000 tons was produced in 1918, and the rest in 1929 and in 1934. There was no production during World War II. The mine was idle when visited, but the lessee was making plans to operate the property.

Development consists of a few open cuts, drifts, and shafts, the largest of which is said to be 60 feet deep. The deposit consists of manganese oxide occurring as segregations and veinlets along fissures and brecciated zones in limestone. Various deposits are scattered over a length of half a mile in a limestone bed. The limestone strikes northwest and dips 10° to 20° NE. The limestone is white to gray, in places pink, and is dense to finely crystalline. It is interbedded with quartzite and quartz-mica schist, representing recrystallized sediments. At least two other narrow beds of limestone occur southwest of the main belt, but they contain little manganese.

The manganese ore is concentrated particularly in fissures and brecciated zones in the limestone, but narrow veinlets a fraction of an inch to 3 inches thick have spread out over broad areas. Many of the open cuts expose zones of interpenetrating veinlets. The manganese oxide is mostly of the hard, blue-black, mammillary and botryoidal psilomelane type. It is accompanied in some places by gypsum, and a little calcite and iron oxide. In two or three places fragments of quartzite and of quartz-mica schist, similar to the beds underlying the limestone, are cemented by the manganese oxide. The deepest shaft, at the southeast end of the property, appears to be located on a cross fissure trending northeast across the limestone. This fissure is accompanied by a brecciated zone cemented with manganese oxide. Brecciated zones were also seen elsewhere on the property. Manganese oxide has probably replaced the limestone in part along these zones. The veinlets of manganese oxide extending into the limestone seem to have followed joints in part, but in part their distribution appears to be irregular. A sample of the rich ore ran 45.1 percent manganese, 3.88 percent silica, 0.6 percent iron, 0.17 percent sulphur, and .041 percent phosphorus.

The ore shipped during World War I is reported to have contained about 40 percent manganese. Very careful sorting would be required to produce much additional ore of this grade. Most of the thick concentrations of manganese oxide seem to have been fairly well mined out, and the material which is left contains a proportion of wall rock. An assay of one of the dumps left during World War I revealed 29.30 percent manganese. It should be possible to obtain about 1,000 tons of ore containing 20 percent manganese. A much larger quantity of lower-grade ore is present, if the narrow veinlets of manganese oxide separated by wall rock are considered as ore. The economic possibilities would seem to hinge upon the price which might be paid for ore of this low a grade.

No. 9. Mountaineer Mine. (By Ivan F. Wilson, March 20, 1943.) The Mountaineer mine is on the east slope of the Riverside Mountains, 7 miles by road south of Vidal, a station on the Santa Fe Railroad. It is reached by proceeding south from Vidal on the road toward Blythe for 6 miles, then turning west for 1 mile. The mine is in sec. 31, T. 1 S., R. 24 E., and is owned by the Mountaineer Mining Company, Hugh Gordon, President, 453 Spring Street, Los Angeles. It was leased in 1939 to H. H. B. Carter of Los Angeles. The caretaker of the property and owner of an interest is John T. Lillard, Vidal.

The mine was developed for gold and copper. The production of these metals is not known, and no manganese has been produced. The mine was last operated in May 1942. Development consists of an inclined shaft which is said to be 360 feet deep. The shaft slopes northwest and is on the south side of a steep canyon running eastward from the Riverside Mountains. A tunnel also is on the north side of the canyon. The mine is equipped with a mill, tracks, blacksmith shop, and hoisting equipment.

The shaft is on a fissure in limestone. This fissure strikes N. 20° W., and dips 75° E. The limestone is gray to buff and massive. It is interbedded with quartzite. In the vicinity of the shaft the limestone strikes

N. 65° E., and dips 40° NW. Manganese and iron oxides are developed along the fissure in limestone. At the top of the inclined shaft they appear to have spread out along the bedding planes for a short distance. They occur in irregular pockets up to 2 or 3 feet thick. An assay of the material from the top of the inclined shaft gives manganese, 8.19 percent; iron, 31.64 percent, and silica, 2.36 percent.

No. 10. Paddy Faulkner Claim. (By Ivan F. Wilson, March 24, 1943.) The Paddy Faulkner claim is 14 miles by road south of Rice, 1.5 miles west of the Rice to Blythe road, and 5 miles northwest of Midland, which is a station on the Santa Fe Railroad (Blythe Branch). It is on the southwest slope of an isolated hill about a mile northeast of the Little Maria Mountains. The property is probably in the eastern part of T. 3 S., R. 20 E. The claim was located by Herman Kiel on April 24, 1942. No production is reported, and the property was idle when visited. Development consists of an open cut about 6 by 6 feet and 4 feet deep, and 3 or 4 other smaller cuts.

The deposit consists of pockets and veinlets of manganese oxide in limestone. The limestone is buff-colored and finely crystalline. It is interbedded with quartzite and quartz-mica schist. It strikes N. 75° E., and dips 65° N. The ore seems to be localized by cross fissures striking north. Irregular pockets have developed along these fissures. At the main cut is an irregular mass of ore 1 foot to 2 feet thick and 5 feet long. Three other small pockets are exposed over a length of 200 feet. East of the main cut an irregular lenslike body extends along the strike of the limestone for 10 feet. Smaller stringers of manganese oxide cut the limestone. The ore is partly of the botryoidal psilomelane type, partly a soft crystalline mineral resembling pyrolusite, and partly soft black impure manganese oxide. Some gypsum occurs in the ore.

No deposit is of the same general type as the Langdon (Riverside 8), which occurs farther south in the Little Maria Mountains, and is probably in the same group of rocks, but it is much smaller than the Langdon deposit. The deposit is of such small size that it is of little economic interest.

No. 11. Palen Mountains Deposit. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 59, 1918.) Frank Coffey of Mecca owns several manganese claims in the Palen Mountains northeast of Blythe. They are probably in T. 4 W., R. 18 E., and presumably the ore occurs in typical fissure deposits.

No. 12. Pinkham Prospect. (From files of U. S. Geological Survey, 1916.) The Pinkham prospect is 10 miles east of Mecca in the southwest part of T. 6 S., R. 11 E. It is said to be owned by Chester A. Pinkham. The indications of ore are said to be blocks of float of manganese oxide.

SAN BENITO COUNTY

No. 1. Chambers Deposit. (By Ivan F. Wilson, March 2, 1943.) The Chambers deposit is on the east side of Bitterwater Valley in the S½ sec. 11, T. 18 S., R. 9 E. The owner is T. B. Chambers of King City. The deposit is 1 mile by road east of the Chambers ranch house, which in turn is 1.5 miles south of Bitterwater. The nearest shipping point is King City, 17 miles southwest. The property is undeveloped, except for a few small holes.

The deposit is on a low knoll containing a narrow zone of chert of the Franciscan group in a rift zone along the San Andreas fault. Etchegoin (Pliocene) beds occur to the east and Monterey (?) (Miocene) to the west. The knoll is composed of thin-bedded red chert, enclosing a massive bed of manganiferous red, buff, and orange chert. The manganiferous bed has a thickness of 0.5 to 2 feet and is 100 feet in length. The chert is crumpled in detail, but has a general strike of N. 25° W., and a dip of 15° W.

A few seams of cherty hard psilomelane-type ore 1 inch to 2 inches thick occur in the chert. Most of the "ore" consists merely of stains and coatings of manganese oxide. Some of the manganese-stained chert is heavier than ordinary chert and may contain bementite or some other hydrous manganese silicate. An assay of some of the most favorable looking oxidized material gave 17.11 percent manganese.

No. 2. Fries Ranch Mine. (By Max D. Crittenden, Jr., September 25, 1942.) The Fries Ranch mine is in secs. 5 and 8, T. 13 S., R 8 E. It is reached via Quien Sabe Valley, a distance of about 25 miles by road from Hollister, the nearest shipping point. The Fries Ranch is now part of the Rancho Quien Sabe, owned by Mr. Ramon Samovia of Los Angeles.

The mine has been developed by means of several intersecting open cuts. These expose more or less homoclinal beds of green, white, and cream-colored chert of the Franciscan group. The beds strike northwest, and dip about 35° SW. at the mouth of the cut, but steepen and become vertical or overturned at the eastern end.

The single bed of manganese ore observed near the southwest end of the open cut is about a foot thick. Weathering has produced secondary oxides to a depth of at least 8 feet, but the resulting oxide is only moderate in grade, and is filled with porous silica and chert. Hand specimens contain up to 50 percent manganese, but not over 5 tons of ore containing 35 percent manganese are visible.

No. 3. Hannagan Ranch Deposit. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 60, 1918.) The Hannagan Ranch deposit occurs in the SE¼SW¼ sec. 22, T. 15 S., R. 9 E., about 31 miles by road southeast of Tres Pinos, at the base of a low hill at the west end of Big Panoche Valley. The New Idria road runs within 1,000 feet of the deposit. The ore does not crop out, but a 3-foot bed of ore is exposed in an open cut. The jasper in the vicinity is heavily stained with manganese. The deposit is under option to E. T. Stewart of Dos Palos, and was idle when visited.

No. 4. Hawkins Mine. (By Max Crittenden, Jr., September 28, 1942.) The Hawkins mine is in sec. 35, T. 11 S., R. 6 E., 12.5 miles by road northeast of Hollister, the nearest shipping point. It is owned by T. S. Hawkins of Hollister. The mine was opened in 1916 and 1917, and a total of 239 tons of ore containing 30 to 42 percent manganese was shipped.[1]

Lenses of manganiferous chert are in intensely fractured and hydrothermally altered chert of the Franciscan. The shearing and alteration has almost completely obliterated the original attitude and makes obscure the nature of the primary manganese ores. The chert is surrounded by sandstone and shale which on the contact has been altered to glaucophane, chlorite, and epidote rocks.

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[1] California Min. Bur. Bull. 76, p. 60, 1918.

The ore in place is secondary and it consists of porous black oxide coatings, stringers and veinlets. At the north end of the southernmost open cut is a vein of black oxide 1 foot wide. It consists of lenticular masses, separated by calcite veinlets. This lenticular mass grades laterally into low-grade mixed ore consisting of veinlets and coatings of oxide cutting and enclosing altered chert, or powdery or ocherous masses of silica. The black oxide itself is of high grade, containing probably 40 percent manganese. The surrounding areas of mixed ore presumably do not contain more than 25 or 30 percent manganese. This mixed ore is exposed for a width of several feet in the north face of the cut, but it does not appear in the south face.

No. 5. Hendricks (Cleveland) Mine. (By Max D. Crittenden Jr., September 25, 1942.) The Hendricks property consists of 80 acres of patented land located in sec. 24, T. 13 S., R. 8 E. It is enclosed by parts of the Rancho Quien Sabe, owned by Ramon Samovia of Los Angeles. The property is about half a mile from the road and is 27 miles from Hollister, the nearest shipping point. The mine is at present owned by several people. John Burmeister owns the largest interest, followed by Mrs. Briggs and L. E. Thornton, all of Hollister. It is leased to Cecil Smith and Roy Harris of Bakersfield.[2] The present investigation indicates, however, that the ore bodies are smaller than that description would imply. No ore has yet been produced.

The ore beds have been trenched along the strike for a linear distance of 125 feet. The deformation of the beds causes these trenches to have a sinuous form. They range in depth from 3 feet at the north end to 8 feet on the south. An adit has been driven into the hill 175 feet west and 50 feet below the surface outcrops. This adit intersects the ore bed 110 feet from the portal.

The Hendricks mine is in a folded and faulted area of chert of the Franciscan group, which contains interbeds of manganiferous chert, and manganese silicate beds 1 foot to 3 feet thick. Though it is thought that only a single bed is present, the intricate folding makes this interpretation uncertain.

The northern trenches follow what is probably a single bed through an adjoining anticline and syncline. These structures plunge steeply to the west. The southern trench is 8 feet deep and follows a bed of soft, high-grade oxide ore 1 foot to 3 feet thick, located on the contact of a bed of massive red-brown chert 6 feet thick.[3] The ore in this bed consists of spongy black oxide with cores of primary, reddish-brown, granular chalcedonic ore. Some rhodochrosite is also present. This bed grades into the massive reddish-brown chert bed to the north, but the thin-bedded greenish chert that forms the south wall appears to be faulted, as it strikes into the manganese ore at a small angle.

The northern bed is less well exposed, but judging from the material on the dump adjacent to the trench, it is the same as the first bed. The small anticline seems to have been offset. In addition to the faults described above, which are at least in part along the bedding, a marked shear zone is 30 feet from the mouth of the adit.

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[2] California Min. Bur. Bull. 76, p. 60, 1918.
[3] California Min. Bur. Bull. 76, p. 60, 1918.

No. 6. Lewis Ranch. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 61, 1918.) A small deposit of manganese ore associated with chert, crops out near the top of a mountain in sec. 7, T. 13 S., R. 8 E. The owner is W. Lewis of Tres Pinos. This deposit adjoins the Fries Ranch deposit (San Benito 2) in sec. 8, and is of the same character. The road from Hollister and Tres Pinos extends to the ranch house below the deposit. The property is undeveloped.

No. 7. McCreary Ranch. (By Ivan F. Wilson, March 2, 1943.) The McCreary Ranch deposit is north of Antelope Creek in the S½ sec. 29, T. 14 S., R. 9 E. It is on the McCreary Ranch (shown on the topographic map as Rancho Real de las Aguilas) and is leased to R. R. Stephenson of Oakland. It is reached by proceeding east from Hollister and Paicines over the Tres Pinos Creek road and turning north from Antelope School over a poor road for 2.5 miles. The mine is 0.3 mile distant from the end of the road. The nearest shipping point is Hollister, 35 miles by road to the west. The men have been working on the property at intervals, although it was idle when visited. A compressor is located on the property. No ore has been shipped yet. Two open cuts have been developed on a steep southwestern slope.

The deposit is typical of those in the Franciscan. It contains only a small amount of high-grade ore. The best ore is exposed in the western cut, from which about 5 tons has been removed and stock piled at the mine. The ore is enclosed in massive, white, and pale-green chert stained with manganese oxide. Quartz veinlets up to 2 inches thick cut the ore. Manganese is exposed in a bed 2 feet thick in the face of the western cut. The boundary with the chert is irregular, and the ore is pockety.

The eastern cut contains a massive manganiferous white chert bed enclosed in thin-bedded white and pale-green chert. One pocket of high-grade ore about 1 foot thick is now exposed in the cut. No continuous bed is present. The massive chert is thoroughly stained and contains seams of manganese oxide half an inch thick. The massive chert may contain bementite or neotocite. The chert in the eastern cut is crumpled and has a general strike of N. 35° E., and a dip of 40° NW. The two open cuts apparently are not located at the same horizon. The chert is bordered by greenstone, but the main rock in this general area is sandstone of the Franciscan.

The ore that has been mined is high-grade black manganese oxide. It consists chiefly of the hard, blue-black psilomelane type, minutely botryoidal and porous. Some soft black oxide is also present, and a few radial fibrous crystals of a black oxide mineral were noted. The ore is coated red with films of hematite and contains a few patches of cellular silica. Most of the ore which has been mined is nearly free of visible silica. An assay of the ore mined is manganese, 53.72 percent; iron, 1.29 percent; silica, 2.51 percent.

SAN BERNARDINO COUNTY

No. 1. Andreen Prospect. (From files of U. S. Geological Survey, 1918.) The Andreen prospect is said to be located in sec. 18, T. 8 N., R. 8 E., about 5 miles north of Ludlow. It is owned by H. M. Andreen. No other information is available.

No. 2. Big Reef Deposit (Black Butte, Hangover, Bobbie, Sullivan, End Line). (By Ivan F. Wilson, March 29, 1943.) The Big Reef deposit is 2.5 miles north of Pisgah Siding on the Santa Fe Railroad, between Newberry and Ludlow, in sec. 10, T. 8 N., R. 6 E. It is situated at the southern base of an isolated hill south of the Cady Mountains. The mine may be reached by proceeding along the highway west of Ludlow. At 10.3 miles from Ludlow the highway crosses the railroad tracks to the south, but a dirt road is followed along the north side of the tracks. At 13 miles from Ludlow a road turns north to the mine, which is a total distance of 15.4 miles from Ludlow. Six claims, called the Big Reef, Black Butte, Hangover, Bobbie, Sullivan, and End Line were located by C. S. Van Doren. These claims were leased in 1939 to H. Weir Hess. The property is said to be leased now to M. R. Fisher of San Bernardino, who has a contract to ship ore to the Kaiser Company, Inc., at Fontana. Some ore has been shipped, but the exact amount is unknown. The property was idle when visited.

Two tunnels have been driven into the slope N. 10° W. The lower tunnel and adjoining cut is 74 feet long. A small crosscut 6 feet long was made in the west wall 50 feet in from the surface. The upper tunnel was started 41 feet north of the lower tunnel and 19 feet higher in elevation. The upper tunnel and adjoining cut is 57 feet long. At the end is a 7-foot crosscut running N. 50° W. The total length explored from the mouth of the lower tunnel to the end of the upper tunnel is 98 feet.

The deposit consists of a brecciated zone in andesite in which fragments of wall rock are cemented with manganese oxide. The matrix of the breccia has been impregnated and partly replaced. The fragments of wall rock are coated and cut by tiny veinlets of manganese oxide. Well defined veinlets of manganese oxide cut through the matrix, as do also veinlets of white calcite, which in places contain vugs lined with coarse crystals. Some crystalline gypsum is present.

The ore body is developed along a fissure which has a smooth footwall and a gradational hanging wall (fig. 4). The footwall is well exposed at the mouth of the lower tunnel, where it strikes N. 10° W., and dips 82° W. It has a smooth polished red jasperoid surface, which in places resembles polished marble. The footwall becomes warped and overturned near the end of both the lower and upper tunnels. At a distance of 66 feet from the mouth of the lower tunnel the footwall makes an abrupt flexure, and from this point to the end of the tunnel it strikes north and dips 80° E. At the end of the upper tunnel the footwall is also overturned; here it strikes N. 10° W., and dips 75° E. At the mouth of the upper tunnel are two distinct polished footwalls about 1 foot apart. The fissure may be traced at intervals for a distance of several hundred feet north of the tunnels, but it appears to be nearly barren of manganese beyond the tunnels, at least at the surface.

The main ore zone is 6 to 8 feet wide. The hanging wall is gradational and veinlets of manganese oxide extend 10 to 15 feet west of the main zone. In the lower tunnel is a nearly barren zone 8 inches to 1 foot thick immediately adjacent to the smooth footwall. This barren footwall is contrary to the usual fissure deposit, in which the best ore occurs along the footwall. The ore body decreases in grade toward the end of both the lower and upper tunnels; in fact, the face of the lower tunnel is nearly barren of manganese. The face reveals a few veinlets of manganese oxide, but the matrix of the breccia is not impregnated, as it is near the mouth of the tunnel. This decrease in grade is thought to be a function of depth

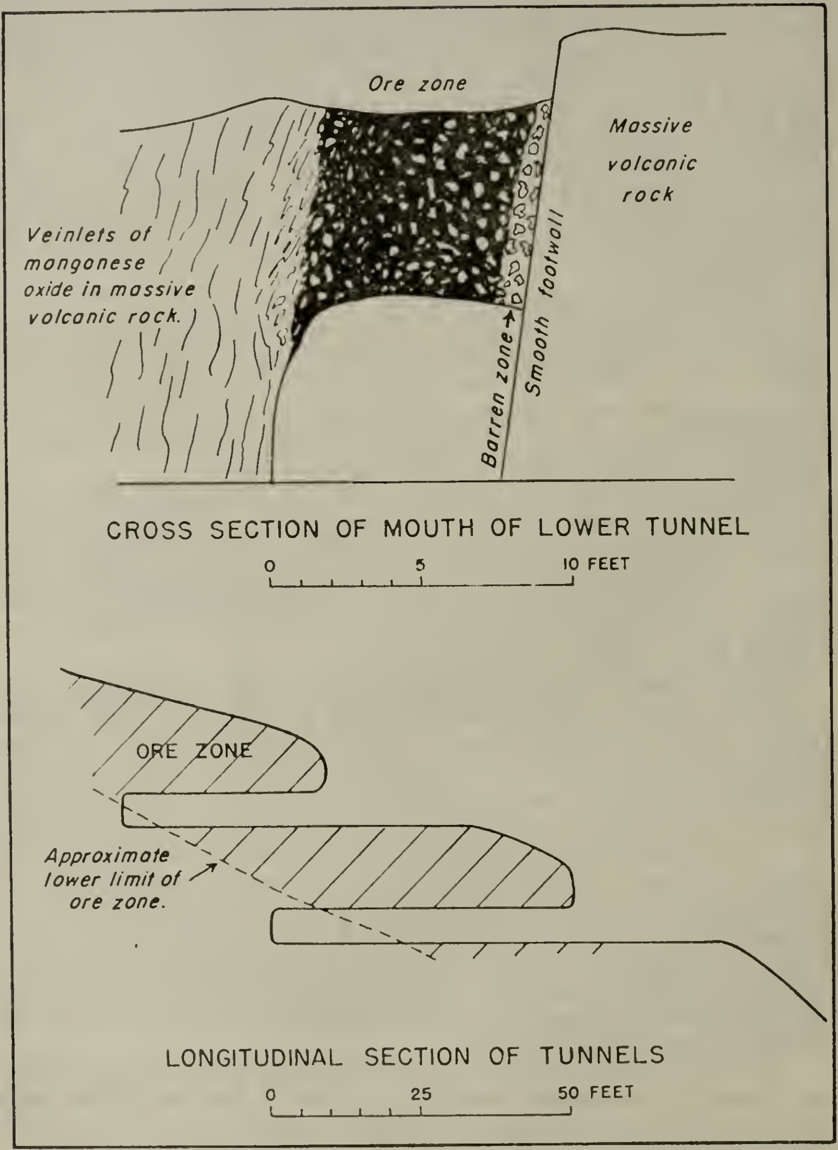
Ore zone
Massive volcanic rock
Veinlets of manganese oxide in massive volcanic rock.
Smooth footwall
Barren zone
CROSS SECTION OF MOUTH OF LOWER TUNNEL
0 5 10 FEET
ORE ZONE
Approximate lower limit of ore zone.
LONGITUDINAL SECTION OF TUNNELS
0 25 50 FEET

FIGURE 4. Vertical sections of the Big Reef deposit, San Bernardino County, California. *Geology by I. F. Wilson, 1943.*

below the surface. It is judged that the limiting depth of ore of the type occurring at the surface is about 25 feet in this particular deposit.

The manganese oxide is mostly of the psilomelane type, black and hard, possessing botryoidal and concentric structures. There is also a considerable amount of a soft, black crystalline mineral with a black streak, which is possibly pyrolusite. This mineral lines vugs and occurs in concentric forms. A fibrous dark-gray or black mineral is also present, along with impure soft black oxide.

Typical samples had the following composition:

	Lower tunnel (percent)	Upper tunnel (percent)
Mn	32.97	35.70
Fe	1.29	1.78
SiO_2	17.85	19.07

About 1,000 feet north of the tunnels another ore zone is exposed in open cuts. This zone is along the line of strike of the fissure at the tunnels, but the ore body cannot be traced between the tunnels and open cuts. Several fault surfaces are exposed in the intervening distance. An ore zone 2 to 5 feet wide is exposed in two open cuts, one 62 feet long and 8 feet deep, and the other, 50 feet farther north, 25 feet long. This ore zone consists of veinlets of psilomelane and a fibrous manganese oxide surrounding fragments of andesite. The individual veinlets range from a fraction of an inch to 5 inches in thickness. The wall rock is so thick that it would probably not be economically feasible to mine this type of material. The economic possibilities of the mine would seem to lie chiefly in the possibility of utilization of ore containing less than 35 percent manganese.

No. 3. Black Beauty Deposits. (By Ivan F. Wilson, October 31, 1942.) The Black Beauty group of claims, Nos. 1, 2, 3, 4, and 5, is in the Granite Mountains, east of the road between Barstow and Death Valley, in T. 15 N., R. 6 E. The location notices give the location as 14 miles southwest of Silver Lake, 20 miles southeast of Cave Springs, and 9 miles east of the sign on the Barstow-Cave Springs road which reads 56 miles to Barstow. The total distance to Barstow is 65 miles. The claims were located June 19, 1940, by R. A. Koontz of Anaheim; W. H. Kimball, Jr., of Seal Beach; and H. E. Ellis (deceased). The interests of the locators are handled by Newton E. Anderson, Attorney, of Los Angeles. A small amount of development was done on the claims in 1940.

Since the claims were located, the property has been included in the Mojave Anti-Aircraft Range of the U. S. Army. The attempted visit of the writer was prevented by firing on the range.

No. 4. Black Mountain (Gallagher) Claims. (By R. R. Morse, September 25, 1918.) A few small outcrops of manganese ore occurring on the Black Mountain claims are scattered over several copper claims situated 8 to 10 miles northwest of Needles, on the southern slopes of the Dead Mountains, in what is sometimes locally referred to as the Ibex Mining district. The claims are in secs. 17 and 20, T. 10 N., R. 22 E., comprising an area of 930 acres. The distance to Java Station, the nearest railway point, is 2 to 4 miles. The Colorado River passes 4 to 5 miles east of the claims. The altitude in the vicinity of the outcrops varies from 1,000 to 1,500 feet above sea level, the lowest being about 100 feet above the siding at Java. The claims may be reached from the latter point by crossing a sandy flood plain known as Sacramento Wash. No water or timber is to be had from points nearer than Needles or the Colorado River.

These claims were originally located as a copper prospect. Several pits and a 30-foot shaft exposed faint copper stains. Several small discontinuous bunches of manganese ore were discovered after a severe rainstorm in the spring of 1918. Since this event, the present owners, T. E. Gallagher and J. W. Arrington of Needles, have removed a few hundred pounds of the ore and have opened several pockets not previously exposed.

The ore occurs in small scattered lens-shaped bodies in granodiorite gneiss. So far as determinable from present outcrops these ore bodies are discontinuous and follow no apparent structural feature. The bunches of ore are generally less than 10 feet long, and 6 inches to 3 feet wide. Wherever prospected sufficiently the bodies have been found to extend but a few feet in depth. The contact with the gneiss is sharp, the ore generally being encased in a thin selvedge of cream-colored lime carbonate. The gneiss ranges from coarse-banded porphyritic augen gneiss to finer gneissic granite porphyry. Typical augen gneiss is of common occurrence, the augen consisting of quartz and feldspar, both orthoclase and oligoclase, surrounded by wavy layers of darker ferromagnesian minerals, chief of which is biotite. From the similarity to published descriptions of gneiss occurring in nearby districts, these rocks are probably pre-Cambrian.

The ore is chiefly psilomelane with calcite. The psilomelane shows a strong tendency to develop concentric structures in which thin layers of dull sooty oxide alternate with wider bands of steel-blue psilomelane. Many thin bands of red iron oxide also are present. Locally in the massive areas of psilomelane is a faint spherulitic structure which is believed to be due to minute aggregates of crystalline pyrolusite.

The ore is of a homogeneous character. It is hard and breaks out readily from the enclosing gneiss. A characteristic sample gave the following analysis: manganese, 40.2 percent; silica, 7.9 percent; ferric oxide, 8.4 percent; phosphorus, trace. A second sample taken from a small lens cropping out 1 mile distant from that represented by the above analysis gave the following results: manganese, 39.43 percent; iron, 6.96 percent; calcium, 12 percent; phosphorus, trace; insoluble, 1.30 percent.

From the appearance of the ore of the various small bodies now exposed, it is probable that an average analysis would run about as follows:

Estimated composition average ore

	Percent
Mn	35
Fe_2O_3	5 to 15
$CaCO_3$	15 to 25
SiO_2	5 to 15

No. 5. Black Prince Group (Manganese Cliff, Manganese King). (Modified slightly from original description in California Min. Bur. Bull. 76, p. 61, 1918.) The Black Prince holdings consist of four claims on the

north slope of the Avawatz Mountains in secs. 4 and 5, T. 17 N., R. 4 E., about 35 miles west of Riggs Station, on the Tonopah and Tidewater Railroad. Massive iron-stained outcrops of brecciated andesite strike east and are cut by a series of small veins of manganese oxide. The silica content of these veins is high. The claims are owned by C. S. Van Horn and C. E. Burckhardt of Daggett.

No. 6. Black Raven (Lankin) Prospect. (By R. R. Morse, September 21, 1918.) The Black Raven prospect consists of three lode claims in the volcanic rocks on the north face of Newberry Mountain, about 1 mile south of the railway station in sec. 4, T. 8 N., R. 3 E. The locator and present owner is Hans von Lankin of Wagner, San Bernardino County. Newberry Mountain presents the usual bare and rugged aspects common to the ranges of the desert, rising abruptly from the arid plain without transitional slopes. The north half of the mountain consists of red weathering rhyolitic flows and agglomerates, forming extremely resistant and rugged outcrops, at the basis of which steep aprons of loose angular talus make approach difficult. The volcanics are frequently cut by small veinlets of calcite and less often by veins a few inches in width in which the calcite commonly takes the form of dog-tooth spar. A few veinlets consisting of chalcedony and opal in places banded with iron and manganese oxides, follow irregular courses across the volcanics.

The claims were located to include a belt of conspicuous outcrops in which coarse- and fine-grained calcite, chalcedony, and opal, with varying amounts of massive psilomelane, occur in a shattered zone along an east west line of faulting, cutting rhyolite agglomerate. This zone appears prominently 1,000 feet up the mountainside above the highway, in the vicinity of the Lankin well. From this point the zone may be traced westward for 1,500 feet to an altitude of about 500 feet above the desert plain. The shear zone, partly occupied by the introduced minerals, ranges in width from a few feet to 50 feet. On the south it is generally limited by a sharp slickensided wall of hard deep-red agglomerate. On the north the limits of the zone are less definite; rhyolite and rhyolite agglomerate occur in the form of firmly cemented breccia and in shattered or sheeted layers for many feet out from the hard agglomerate wall. Beyond this zone to the north are gray rhyolitic ash and fine agglomerate.

The deep-red agglomerate is composed of unsorted coarse and fine angular fragments of gray rhyolite in an ashy matrix stained red by an abundance of finely disseminated iron oxide. The lighter-colored agglomerate to the north of the shear zone lacks the iron-stained matrix and coarser fragments of rhyolite so characteristic of the agglomerate south of the zone. The constituent fragments are pinkish orthoclase, quartz, and rhyolite, generally less than one-tenth of an inch in diameter, and the matrix is extremely fine rhyolitic ash.

Within this sheared zone occur stringers and wider veins of black calcite, with thin selvedges and a few narrow irregular bodies of psilomelane and a minor amount of intermixed calcite. These calcite veins vary in width from a few inches to 14 feet. They are broken by thin bands and irregular included blocks of sheared rhyolite agglomerate. The included psilomelane masses are never more than a few inches in width. Though the calcite filling is traceable practically continuously along the shear zone, the psilomelane bodies occur in the calcite as isolated discontinuous masses or shoots of but a few feet in length.

The calcite is coarsely crystalline, occurring both as bands of long slender needles, arranged at right angles to the walls, and as stocky rhombohedrons. It appears jet black to the eye, but under the microscope the fragments are seen to consist of colorless calcite within which are scattered finely disseminated and larger aggregates of black manganese oxide.

Small amounts of fault breccia ore consist of angular agglomerate fragments cemented by calcite and psilomelane. The rocks gradually become less shattered west of the fault zone, and the ore body narrows in width, until at the west end of the claims it is represented only by a thin vein, 1 foot to 3 feet in width, consisting of light and dark banded chalcedony and opal. A center band 2 to 6 inches in width consists of an intimate mixture of manganese oxide and calcite.

No. 7. Black Stone Deposit. (Modified slightly from original description in California Min. Bur. Rept. 17, p. 354, 1921.) The Black Stone deposit is 3 miles southeast of Afton, a station on the Salt Lake Railroad in sec. 28, T. 11 N., R. 6 E. on a ridge east of the Mojave River at an altitude of 2,600 feet. A series of lenses of manganese are on the contact between granite and limestone, throughout a distance of 1,000 feet. The strike of the contact is north and south, and the dip is 70° E. The largest lens is 50 feet in length and 8 to 10 feet wide. The manganiferous zone can be traced for a mile, and at intervals shows from 8 inches to 4 feet of ore. Manganese occurs in form of psilomelane with a small amount of pyrolusite. The property is undeveloped. The owner is J. H. Massen of Yermo.

No. 8. Dawson Deposit (McDowell, Black Chief). (By Ivan F. Wilson, March 21, 1943.) Some undeveloped claims located by E. W. McDowell in World War I have been relocated under the name of Black Chief by J. H. Dawson of Parker Dam. The claims are half a mile west of Lake Havasu, 2 miles by boat northwest of the Dawson boat landing. This boat landing is at a point opposite the Thompson mine on the Arizona side of the lake and is near the Orchard deposits (San Bernardino 16). The boat landing is 14 miles northwest of Parker Dam and 30 miles from Parker, Arizona. The deposit is probably in sec. 32 or 33, T. 4 N., R. 26 E. It is in the lower end of what was known as Little Chamehueve Valley, before this was flooded by Lake Havasu.

The deposit consists of stringers of manganese oxide filling fissures in a flow of vesicular and amygdaloidal basalt. The basalt is 100 feet wide and may be traced for perhaps 500 yards. It strikes east and dips 30° S. On the north it is in fault contact with granite. On the south it is overlain by brown sandstone which has a similar strike and dip. A transverse fault brings granite against the sandstone to the west, and another transverse fault was noted farther east along the northern granite belt. Gray limestone is interbedded with the sandstone farther east, and a copper prospect that contains chrysocolla and is said to carry gold, occurs in the limestone.

The stringers of manganese oxide strike north, ranging from N. 10° W. to N. 10° E. and stand vertically or dip steeply to the west or east. A series of a dozen or so stringers ranging from 1 inch to 4 inches in thickness was seen over a distance of several hundred feet. The stringers may be traced for a few feet to 50 feet along the length. All terminate against the granite to the north. A few smaller stringers striking east, branch off, but all of the major ones strike north. The stringers consist mainly of banded psilomelane accompanied by soft black oxide. In a few places a dark-gray crystalline oxide was noted. The manganese is accompanied by calcite and in some places by hematite. The larger veins contain brecciated fragments of wall rock. One vein carries narrow bands of chalcedony along its borders. Another vein widens to a thickness of 1 foot for a short distance, and two others reached a thickness of 6 inches. These seem to contain greater amounts of wall rock and of hematite than the smaller stringers, although it is likely that they would run around 35 percent manganese.

No. 9. Emma (Black Magic) Deposit. (By C. B. Hunt and Edgar Bowles, 1942.) The Emma or Black Magic deposit is located in sec. 16, T. 18 N., R. 3 E., in the Owlshead Mountains 35 miles from the railroad. The owners are S. F. Brock, John Rayburn, and J. W. Hilliard. The property is leased to Harry Nasland and associates of Beverly Hills. The deposit is a typical fissure deposit. It consists of a mixture of hard and sooty manganese oxides in a breccia of limestone and granite. The manganese is found in pockets containing at most only a few tons of ore. It is estimated that at least 10 tons of waste must be removed for each ton of ore. The brecciated limestone and granite belong to the Virgin Spring phase of the Amargosa chaos. The deposit is a few miles north of the Garlock fault. Development consists of an inclined shaft 40 feet in depth. Production up to the time the property was visited in 1942 was 302 tons, averaging 34.8 percent manganese.

No. 10. Lee Yim Deposit (Garringer, Lavic Mountain, Manganese 1-10). (By Ivan F. Wilson, March 28, 1943.) The Lee Yim deposit is 5 miles northwest of Ludlow in T. 8 N., R. 7 E. It is reached by proceeding along the highway west of Ludlow for 0.5 mile, then turning northwest along a dirt road for 4.4 miles. The mine lies 0.3 mile east of the end of the road up a steep slope. During World War I a rail tramway went up this slope. The manganese deposits are scattered over an east-west length of 1,500 feet on the surface of gentle relief bordered by steep slopes to the northeast and southwest. These scarps probably are fault scarps. The surface is on a spur running southeast from the Cady Mountains.

Ten claims have been located, called Manganese Nos. 1 to 10. They are owned by A. N. Rabe and L. W. Yim. The mine was leased March 10, 1942, to J. M. Elmer and Walter W. Johnson of the Gold Hill Dredging Company, San Francisco. During World War I this mine was known as the Garringer mine. It has also been known as the Lavic Mountain deposit.

Production during World War I is recorded as 100 tons containing 38 percent manganese, 1 percent iron, and 10 percent silica. Some development was done during 1942, but no ore was shipped, so far as known. Previous development consists of 17 open cuts, and one shaft 42 feet deep near the west end of the main zone. The shaft is inclined 70° SW. From the bottom a drift was run 35 feet S. 80° W. Another drift was run to the east about 10 feet. At a depth of 25 feet down the shaft a drift extends S. 10° W. for 10 feet.

The deposit consists of three brecciated zones 250 feet apart along fissures cemented, impregnated, and partly replaced by manganese oxide. The ore is accompanied by calcite, jasper, and hematite. In the shaft very little manganese oxide occurs below a depth of 20 feet. Hematite and calcite persist to the bottom of the shaft, however. In two or three of the open cuts, oxide appears to give way to hematite at a shallow depth, as little as 5 feet below the surface. The fissures occur in rhyolite and rhyolite breccia. The rock is brownish gray when fresh, but weathers reddish. Shiny films of hematite appear along many joints. The rhyolite contains a few small phenocrysts, in an aphanitic groundmass. The rhyolite has a general northwest strike, and gentle dip to the southwest.

Several fissures occur on the property, of which at least three contain manganese oxide. The principal fissure may be traced for 2,300 feet. Manganese oxide occurs at intervals over only a small part of this distance, however. This fissure has an average strike of N. 65° W., and a dip of 70° NE. Toward the northwest end it is offset and splits into en echelon branches. At the extreme northwest end the fault is overturned and dips 70° SW. The dip passes through the vertical about 400 feet southeast of the shaft. The fissures are marked by smooth footwalls, which in many places stand up as scarps several feet high, all facing northeast. They possess smooth, polished surfaces, on which are seen narrow seams of calcite and jasper. The fissures are accompanied by brecciated zones commonly 1 foot to 10 feet wide. In places narrower zones of breccia extend at an angle into the wall rock. Some of the cemented brecciated zones appear to be more resistant than the surrounding wall rock and stand up in a manner resembling dikes.

Manganese oxide occurs at various places along the fissure zones. Zones cemented by manganese oxide ordinarily have a width of 2 to 3 feet and a length of 30 to 100 feet. At one place northwest of the shaft, manganese oxide veinlets are scattered through a brecciated zone 20 feet thick. The manganese oxide is partly hard botryoidal psilomelane, and partly soft black oxide. In places concentric bands of hard oxide alternate with bands of a softer gray fibrous mineral. The impurities include veinlets of later white calcite, hematite, a little chalcedony, and numerous rock fragments. The average grade of most of the ore zones is 25 or 30 percent manganese. It is thought that sorting of a product containing over 35 percent manganese would be very difficult.

Assays made by the U. S. Bureau of Mines are as follows:

	Percent	
Mn	Fe	SiO_2
30.1	1.82	28.78
28.4	15.86	13.00
33.6	2.22	17.20
31.1	2.00	30.50
22.8	2.38	43.74

Lee Yim Deposit. (By R. R. Morse, September 22, 1918.) The main ore body in the Lee Yim deposit rests in sharp contact against hard red rhyolite agglomerate along the southwest. The pyroclastic nature of this "footwall" is sometimes slightly obscured on the immediate fault face by a polished mirror of brick-red iron oxide. Commencing at the southernmost pit, where the contact of the ore body has been well exposed, this agglomerate footwall extends N. 80° E. for a distance of about 800 feet, weathering out prominently above the bench level. It then turns abruptly west and is easily traceable for an additional 700 feet, beyond which the region was not examined. Throughout this distance the hard footwall dips 75° NE. The manganese oxide ore which rests against it, ranges in width between 2 and 15 feet.

About midway along this zone, a second and parallel belt of oxide ore crops out about 200 feet southwest. Dense, dark-red platy rhyolite lies between. This ore likewise occurs within rhyolite agglomerate, the hard polished footwall of agglomerate dipping steeply northeast. The ore body is traceable at the surface for a distance of 400 feet, its outcrops ranging in width from 1 foot to 4 feet.

In this same locality and for 75 feet northeast of the main ore zone, a third and similar outcrop of ore occurs. This zone, however, is irregular and is not traceable at the surface. Farther northeastward from the ore-bearing agglomerate, and forming the top of the scarp, a red-weathering, greenish-gray rhyolite flow crops out.

The rhyolite agglomerate, because of its superior resistance to weathering, its peculiar texture and bright color, and its association with the ore bodies, is the most prominent member of the bedrock series. It consists of unsorted coarse and fine fragments of fine-grained brownish-gray porphyritic rhyolite embedded in a dense brick-red matrix made up of smaller fragments of rhyolite, quartz, and feldspar, through which a fine red dust of iron oxide is uniformly distributed. The fragments range in size from microscopic particles to 1.5 inches in diameter, sizes of 0.5 to 1 inch predominating. Boundaries of these fragments with the dense matrix are everywhere clear cut; their edges are sharply angular.

These coarser fragments consist entirely of rhyolite in which small phenocrysts of orthoclase are sparsely distributed in a fine-grained crystalline groundmass of alkali feldspars and quartz, glass being entirely lacking. The phenocrysts are 1 millimeter or less in diameter. Minute tabular feldspars with indices of refraction below 1.530 predominate in the groundmass in which also occur scattered grains of magnetite, and a minor amount of quartz. Scattered here and there, probably as original inclusions of the ferromagnesian minerals now partly or completely destroyed, occur small terminated prisms of apatite and an infrequent, highly birefringent needle perhaps representing zircon, but too minute for recognition. An irregular shred of pale-greenish ferromagnesian mineral showing characteristic cleavage angles of amphibole suggests a remnant of hornblende. Numerous dark, largely isotropic patches strongly suggest resorption of original ferromagnesian minerals. Many of these exhibit partial prismatic or tabular outlines and consist largely of fine magnetite, within which are remnants of highly birefringent cores, with the fine magnetite and considerable secondary red hematite dust trailing out in a manner suggesting flowage of the groundmass. These are believed to result from the magmatic resorption of primary hornblende, and perhaps in part biotite. In the groundmass, quartz is not recognizable in great abundance, the texture approaching orthophyric.

The dense red matrix in which these rhyolite fragments are embedded owes its color to an abundance of fine red iron oxide dust. After removal of much of this hematite by leaching, the matrix is seen to consist of rock fragments and of finally comminuted dust of rhyolite, quartz, and orthoclase, all showing ragged edges. The smallest particles are so fine that they are scarcely resolvable by the microscope. The rock is thus seen to be pyroclastic, consisting of rhyolitic tuff and fragments of lava of the same character, and may be termed rhyolite agglomerate.

A second rock type is platy red rhyolite, which crops out between the main ore zone and the adjacent zone to the southwest. Scattered equant or slightly tabular phenocrysts of orthoclase and a few crystals of sodic plagioclase showing simple twinning, occur in a dense microcrystalline groundmass carrying a large amount of red iron oxide. This rock evidently represents a thin rhyolite flow.

A third type is greenish-gray rhyolite. The light colored rhyolite occurring northeast of the ore-bearing agglomerate exhibits scattered phenocrysts of orthoclase and oligoclase with the usual types of twinning in a light colored microcrystalline groundmass. Under the microscope, flowage is indicated by the rough parallelism of the small laths of oligoclase and shorter tabular orthoclase, as well as by a tendency to orientation of the longer phenocrysts. In addition to the phenocrysts visible in the hand specimen are many phenocrysts showing micrographic intergrowths of quartz and orthoclase, as well as microperthitic intergrowths of the feldspars. The larger feldspar phenocrysts are frequently zoned. Embayed quartz boundaries and partly or completely destroyed hornblende prisms indicate magmatic resorption. Other areas of alteration products suggest resorbed biotite. These indications of original ferromagnesian minerals are of more frequent occurrence in this rock than in the two types of rhyolite above described.

The manganese of the ore bodies of these claims is in the form of psilomelane with a minor amount of pyrolusite. Calcite, silica, chiefly in the chalcedonic form, and varying amounts of unaltered rhyolite fragments, constitute the gangue. A sample representing the average character of the ore gave the following analysis: manganese, 32.6 percent; ferric oxide, 1.2 percent; total insolubles, 28 percent.

The insolubles include a small amount of chalcedony and an abundance of small rhyolite fragments with which the ore minerals are closely intermixed. Calcite is present in numerous small veinlets cutting the ore minerals. Larger patches of calcite have grown about the other constituents; so a single cleavage face frequently shows included areas of ore minerals and rhyolite fragments. It is probable that ore of higher manganese content than that of the above analysis could not be economically recovered by ordinary methods of hand sorting.

Except for a narrow seam along the polished fault face of the agglomerate forming the "footwall" of the main ore zone, the ore is everywhere characterized by an agglomeratic texture; sharply angular fragments of rhyolite occurring within and adjacent to masses of psilomelane, which in places serve as an apparent matrix and in other places appear as sharply angular fragments. Locally along the footwall, the ore is massive or faintly banded, or carries veins of coarser calcite up to half an inch in width. Irregularly shaped, barren or nearly barren "horses" of rhyolite agglomerate, and bunches of manganiferous calcite with a few bands or stringers rich in red iron oxide, occur in the ore. The agglomerate of the hanging wall is not so firmly indurated as that of the footwall. Distinction between low-grade ore and barren agglomerate of this transition is rather abrupt.

A polished surface of the ore having the characteristic agglomeratic texture shows sharply bounded fragments of brown rhyolite embedded in and adjacent to areas of steel-blue psilomelane, also bounded by sharp and frequently angular borders, and a few patches of fibrous pyrolusite. Where these abrupt borders are lacking, the psilomelane serves as a matrix. Pyrolusite occurs as shining radiating fibers in numerous small spots, commonly giving the enclosing psilomelane an oolitic or spherulitic appearance. Dull brownish-black powder fills the interspaces between the fibers in a manner suggesting that the fibrous pyrolusite alters to the powder. In many of these spots nearly all the material is now powder, whereas in others, closely packed radiating or stellate fibers occupy most of the area.

In many specimens, a central spherule of fibers and powder of the pyrolusite is surrounded by wavy banded rims of steel-blue psilomelane, or by alternating botryoidal psilomelane and very thin partings of the dull powder, passing outward into a broad area of massive psilomelane, which is sometimes bounded by an outer rim of calcite. These calcite halos are generally connected with one or more of the numerous minute veinlets of calcite which cut the ore at random. Within the inner wavy bands of psilomelane small bunches of pyrolusite fibers may be seen standing at right angles to the banding. On a polished surface of the ore the soft powder largely drops out, leaving the psilomelane with a notable pitted surface.

In many specimens an angular area of massive bright psilomelane contains a small, more or less central kernel of unaltered rhyolite. Careful search fails to reveal embayment of edges or transitional borders of partly replaced rhyolite. On the contrary, the edges of the included fragments are everywhere sharp. In specimens of ore close to the stringer along the footwall is an occasional small irregular patch of hard reddish-brown jasper. In the thin section no manganese minerals other than the oxides mentioned above are evident.

It is evident that a passageway for the solutions depositing manganese minerals has been afforded along the fault cutting the rhyolite agglomerate. The massive ore of the stringer along this hard wall is evidently of vein origin. It would appear that the now softer rock of the hanging-wall side of this fracture was of sufficient permeability to favor a somewhat limited circulation, resulting in the deposition first of manganese minerals, and later of calcite, within the ashy matrix of the agglomerate. To what extent the extremely fine interspacial filling of rhyolitic ash may have been replaced by material from such solutions is not now determinable. It is certain that in many places in the ore, psilomelane is now the chief cementing material, but no definite evidence of the replacement of fragments was observed.

Clues as to the nature of the original manganese mineral deposited are lacking. The oxides present no common features that might be interpreted as inherited structures. One possible exception may be noted, consisting of a small isolated cavity now partly filled with psilomelane, in which may be seen a faintly reticulated structure and parallel parting resembling what in certain other deposits of the state appears to be oxidation of bladed rhodonite to a siliceous oxide ore. The frequent sharp outlines of areas of massive psilomelane in this ore are partly, if not wholly, due to the intersection of calcite veinlets, more or less darkened by admixed manganese oxide powder.

One somewhat different occurrence of psilomelane on the Lee Yim claims should be mentioned for the sake of completeness, though no commercial value is attached to it. This consists of shallow joint or fissure fillings, composed of small angular rock fragments and a few pieces of hard psilomelane embedded in a compact reddish or yellowish-brown matrix of calcium carbonate. This matrix dissolves readily in cold hydrochloric acid leaving suspended a great quantity of fine particles of red hematite and an unattached residue of fragments of psilomelane and rhyolite, a few small shreds of bleached mica, and many travel-worn grains of quartz evidently of detrital origin. The veinlets often have thin outer selvedges and inner bands of massive psilomelane, 1 inch to 2 inches in thickness. The fillings as a whole are seldom over 6 inches thick. They are vertical, or nearly so, and may be traced 50 to 75 feet, cutting the ore zones nearly at right angles.

The ore of these deposits is of a uniformly low grade. The past shipment of carefully sorted ore averaged only 38 percent manganese. It is doubtful that a product of better than 30 percent manganese can be profitably recovered by ordinary methods. Owing to the nature of the impurities the ore would seem better adapted to some form of mechanical concentration, rather than sorting to higher grade or shipping to silicomanganese furnaces.

No. 11. Logan Mine (Trans-Oceanic, Treasure). (By Ivan F. Wilson, March 29, 1943.) The Logan mine is 7 miles northeast of Hector, a station on the Santa Fe Railroad between Ludlow and Newberry. The mine is on the south flank of the Cady Mountains, 300 feet higher than the alluvial plain to the south. A series of cuts is located on the sides and crest of a steep narrow ridge trending southeast. The mine is reached by a dirt road which follows the railroad tracks east of Hector for 2.7 miles, then crosses the tracks to the north through an underpass, and runs northeast. The mine is probably in the southwest part of T. 9 N., R. 6 E. A series of claims known as Treasure 1, 2, 3, and 4 was located May 17, 1930, by E. F. Logan and L. W. Page. Later notices of assessment work are signed only by E. F. Logan. The claims are leased by Suckow Borax Mines Cons., Inc., of Los Angeles. Ore has been shipped under the name of Trans-Oceanic, which is believed to be another name for the same company.

The Sacramento stock pile of the Metal Reserve Company received 59 tons of ore from the Logan mine in 1942. This ore averaged 40.8 percent manganese. In addition the lessees have a contract to ship lower-grade ore to Kaiser Company, Inc., at Fontana, but the exact amount shipped is unknown. A card in the files of the U. S. Geological Survey states that in 1934 Lew Page and E. F. Logan shipped 71 tons of ore containing 44 percent manganese and 2 percent silica.

The property was operated during 1942 and the early part of 1943, but it had been idle for a short time when visited. About 9 or 10 open cuts are distributed along an ore zone 600 feet in length. One of these cuts is 125 feet long, 30 feet wide, and 15 feet deep; two others are about 50 feet long, 10 feet wide, and 10 to 15 feet deep. The rest are smaller.

The deposit consists of a series of veins of calcite and manganese oxide of the psilomelane type distributed over a fairly wide zone in andesite. The veins follow individual fractures in a fissure zone which strikes northwest and dips northeast. The deposit is of a slightly different type from the usual fissure deposits of the desert region, such as the Lee Yim (San Bernardino 10) and Big Reef (San Bernardino 2) deposits. In the latter, wide brecciated zones are cemented, impregnated, and partly replaced by manganese oxide. In the Logan mine, however, instead of a wide brecciated zone, definite veinlets of manganese oxide and calcite fill fractures in the solid wall rock. In this respect the deposit is similar to the Lugo or Palo Verde deposit (Imperial 5).

The veinlets are scattered over a zone 50 feet wide. They are not distributed uniformly over this zone but are concentrated along belts separated by wall rock. In places narrow brecciated zones are impregnated with manganese oxide. Few individual veins attain a thickness of 1 foot; most veins are a fraction of an inch to 3 or 4 inches thick. In places calcite is more abundant than manganese oxide. The calcite is evidently later in origin than the manganese oxide, for it commonly fills the center of the veins; and the calcite also encloses some fragments of psilomelane and fragments of wall rock coated with psilomelane. The calcite is white and coarsely crystalline.

The manganese oxide is mostly of the hard black psilomelane type, exhibiting botryoidal concentric and banded structures. In places are bands of a fibrous mineral, probably pyrolusite or manganite, paralleling the bands of psilomelane. The individual veinlets of manganese oxide are of high grade, but difficulty is encountered in working the deposit, because of the small size of the individual veinlets and the large amounts of wall rock which must be mined. The grade of the product is purely a function of how much sorting is done. The average grade of the zone which has been mined is probably not over 5 or 10 percent manganese, considering the large amount of barren wall rock present, but by sorting, a product containing from 15 to 45 percent manganese could probably be obtained. It is doubtful whether it would be economical to attempt to sort ore meeting Metals Reserve Company standards, because of the large amount of rock that must be mined in order to obtain a small amount of ore. The only possible production in any quantity would probably be ore containing around 20 percent manganese.

The general characteristics of the ore zone are illustrated in a section across the strike taken from southwest to northeast:

	Thickness (feet)
1. Nearly barren andesite containing a few thin veinlets (less than half an inch thick) of psilomelane and calcite along joints or fissures dipping northeast	44
2. Prominent vein of calcite. White, very coarsely crystalline (crystals 1 inch across). Contains a few angular fragments of psilomelane and of wall rock coated with psilomelane. Strike N. 40° W., dip 55° NE.	1½
3. Brecciated zone cemented and impregnated with psilomelane. Rock fragments coated with psilomelane, but with little replacement of the fragments. This zone might run 20 to 25 percent manganese	2
4. Barren wall rock	2
5. Brecciated zone with psilomelane and calcite veinlets	3
6. Barren massive wall rock, except for a few veinlets of calcite and psilomelane, fraction of an inch to 2 or 3 inches thick, mostly dipping northeast. One vein 6 inches thick is about half calcite and half psilomelane. Psilomelane bands are on outside, calcite in center	22
7. Brecciated zone 10 feet thick, more or less penetrated with psilomelane and calcite veinlets, and containing numerous large rock fragments. Some thick veins of coarsely crystalline calcite. Also veins of nearly pure psilomelane 3 to 4 inches thick—in places 6 to 8 inches thick	10
Total	85

No. 12. Monument King Deposit (Manganese King, Hidden Treasure, Cross Roads). (By Ivan F. Wilson, March 17, 1943.) A deposit known as the Monument King, Manganese King, or Hidden Treasure is 2.5 miles west of Monument Peak in the Whipple Mountains, 8 miles west of Cross Roads. Cross Roads is 8 miles north of Parker, Arizona, the site of a Metals Reserve depot. From Cross Roads a road is taken northwest toward Copper Basin. At 4.6 miles from Cross Roads a right turn is made, and the manganese camp is at a total distance of 7.9 miles by road from Cross Roads and 15.7 miles from Parker, Arizona. The main part of the deposit is about 1 mile from the end of the road. This distance is covered by a tractor trail which is too narrow and steep to be used by trucks. Ore has been hauled over this trail by a trailer towed by a tractor. Workings are scattered at intervals along the steep southwest slope of a northwest trending ridge near the head of Whipple Wash. The deposit is in sec. 1, T. 2 N., R. 25 E., and sec. 6, T. 2 N., R. 26 E. It is joined on the southeast by the Moulton deposit (San Bernardino 25). The power of attorney for the property is held by Fred M. Hall of Los Angeles. This property was formerly leased to Moulton and Clark but is now leased to Bowen and Cady. Five or six men have been working on the property.

The deposit was mined during World War I, and was described in reports at that time by Jones [1] as the Hidden Treasure group and as the Hidden Cross properties. This deposit and the Moulton deposit (San Bernardino 13) to the southeast, have been referred to as the Cross Roads deposit. The production from these two mines together was 160 tons in 1917 and 1918, containing 46 percent manganese, 3 percent iron, and 3 percent silica. It is not known what proportion of this came from each mine. In 1943 the property shipped 12 tons containing 39.01 percent manganese to the Metals Reserve depot at Parker, Arizona. Mr. Moulton states that 1,800 tons was shipped from the Monument King (San Bernardino 12) and the Moulton properties during the last war, but this figure seems large in view of the size of the workings.

Development consists of about a dozen open cuts scattered over a length of 3,000 feet. The largest of these is 30 feet long, 12 feet wide, and 15 feet deep, from which ore has been stoped. The deposit consists of manganese oxide and hematite occurring in lenticular bodies associated with jasper in limestone. The limestone is enclosed in a thick series of sediments, mainly brown sandstone and volcanic breccia. The manganese oxide in general lies parallel to the bedding of the limestone; however, in places it seems to cut across the bedding. It is nearly everywhere accompanied by jasper. The manganese oxide is often underlain by jasper; in places it seems to wedge into it along the strike.

The manganese oxide consists mainly of hard blue-black material of the psilomelane type, along with soft black oxide, accompanied by a small amount of calcite and by considerable hematite. The psilomelane is not so markedly botryoidal as in the typical fissure deposits of the desert region. Nearly all of the pieces of manganese oxide are coated with hematite. In some of the deposits fairly large bodies of hematite occur with the manganese oxide, or in place of it. Apparently the manganese oxide may be separated readily from the bulk of the hematite, inasmuch as the ore shipped in World War I carried only 3 percent of iron. The ore is massive, and much of it is high grade, containing probably 45 percent manganese.

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[1] Jones, E. L., Jr., Deposits of manganese ore in southeastern California: U. S. Geol. Survey Bull. 710 E, pp. 185-208, 1919.

No. 13. Moulton (Red Cross) Mine. (By Ivan F. Wilson, March 17, 1943.) The Moulton mine, known during the last war as the Red Cross, adjoins the Monument King property (San Bernardino 12) on the southeast in the Cross Roads district, in secs. 6 and 7, T. 2 N., R. 26 E. It is reached by proceeding northwest from Cross Roads toward Copper Basin and turning right 4.6 miles from Cross Roads. The manganese camp at the end of the road is 7.9 miles from Cross Roads and 15.7 miles from Parker, Arizona. The workings are then 0.1 to 0.2 mile to the north up a steep ridge. A cable tramway down the slope of this ridge was being constructed when the mine was visited. The property is owned by C. E. Moulton and leased to Wm. Bradbury of Parker, Arizona. Five men have been working on the property since January 25, 1943.

The deposit was mined during World War I, along with the Monument King deposit (San Bernardino 12). The production from the two mines together has been listed as 160 tons in 1917 and 1918, containing 46 percent manganese, 5 percent iron, and 3 percent silica. It is not known what proportion of this came from each of the two mines. No ore has been produced from the Moulton property during the present war, but the operators were preparing to ship at the time the property was visited. Development consists of 5 open cuts and 2 small caved tunnels.

The general geology is the same as at the Monument King deposit and the report on that property is referred to for the details. The deposit consists of lenticular bodies of manganese oxide and hematite associated with jasper in limestone, which in turn is enclosed in brown sandstone and volcanic breccia. The manganese oxide may have resulted from replacement of the limestone, or it may represent an original bedded deposit.

Very little ore is now seen in the old workings, which date to World War I. A new open cut was being developed at the time of the writer's visit, and this revealed a bed of solid ore 2.5 to 3 feet thick, exposed for the length of the cut and for an additional 40 or 50 feet. Between 10 and 15 tons of ore has been mined. This ore probably runs over 45 percent manganese. The ore is mostly of the hard psilomelane type, with some calcite and coatings of hematite. The ore body strikes N. 35° W., and dips 70° to 80° SW.

About 1,000 feet north of the open cut mentioned above is an exposure of ore which has been undeveloped, but which the operators are planning to explore in the future. Ore having a thickness of 1 foot to 2 feet is exposed at intervals over a distance of 150 feet. The ore is associated with jasper in limestone, and appears to be a long lenslike body paralleling the bedding of the limestone, although in places it appears to cut across the bedding. The general strike is N. 40° W., and the dip is 40° SW. The ore zone contains alternating concentric bands of material of the hard psilomelane type and soft black oxide. The ore is coated with hematite and contains a small amount of calcite.

No. 14. New Deal Mine (Owl Hole, Owl Head). (By F. S. Hudson, September 25, 1918.) The New Deal, Owl Hole, or Owl Head mine is 1.5 miles northwest of Owl Hole Springs on the southeast flank of the Owl Mountains. It probably is in sec. 18, T. 18 N., R. 3 E., in northeastern San Bernardino County. It is owned jointly by Alex Yoeman, O. H. Stevens, and E. P. Bryan, of Los Angeles. At the time of the writer's visit, the best road for reaching this locality by automobile was from Randsburg via Granite Well, a distance of 70 miles. No great difficulty with soft sand was experienced on this route. An attempt was made to take a shortcut road from Trona to the above mentioned road, northeast of Granite Well. At a point 8 miles east of Spangler Siding, on the American Trona Company's railway, heavy sand was encountered that prevented crossing a low range of hills. The road from Owl Spring to Silver Lake via Saratoga Spring, was said to be very difficult. For this reason an attempt was made to reach Silver Lake by the road around the south side of Leach Lake. Heavy sand barred progress up a canyon in the mountains southeast of Leach Lake. The ore from the mine was hauled by tractor and trailers to Riggs on the Tonopah & Tidewater Railroad, a distance of 45 miles.

The Owl Mountains consist of a core of crystalline rocks including granite and marble, flanked on the south and southeast by sediments of probable Tertiary age. The basal member of these sediments is a thick mass of moderately well consolidated conglomerate, showing no sign of bedding, made up of angular to subangular boulders, predominantly of granite, less commonly of marble, in a matrix of sand and clay. The boulders range in size from a fraction of an inch to several feet in diameter. The formation is without much doubt a middle or early Tertiary fanglomerate. Above this fanglomerate, which is perhaps 1,000 feet thick, are well-bedded, gray and pink sediments, having the appearance of lake deposits. The manganese occurs in veins cutting the conglomerate. The materials of these veins are hematite, black manganese oxides, and boulders derived from the conglomerate walls. No definite walls were seen, the mineralization fading gradually into the conglomerate.

Two sets of workings called the east workings and the main workings are present. In the east workings an ore zone with a maximum width of 30 feet has been proved for over 50 feet vertically and for 100 feet along the northwest strike, by a shaft and open cuts. The ore zone consists of boulders of granite in a matrix of bright red hematite material and black manganese oxides. The northeast wall of the ore zone is coarse granite, the southwest wall is indefinite, as the mineralized zone grades into barren conglomerate.

About 50 feet northeast of the workings is an exposure of granite in intrusive contact with marble. Both rocks are cut by numerous veins 0.5 inch to 1.5 inches wide, but in one place 2.5 feet wide. These veins are composed of psilomelane and calcite: the latter mineral is in the center of the vein and represents a later period of mineralization than the psilomelane.

The northeast part of the ore zone contains the most manganese. It is thought that the mineralizing solutions entered along a fissure that was developed at the contact of the conglomerate with the older rocks, then passed out through smaller fissures into the granite and marble on the one side, and into conglomerate on the other side. Most of the material in solution seemingly was deposited before traveling any great distance.

The ore here cannot be hand sorted to advantage as it contains, in addition to the boulders, a considerable amount of grit and much hematite. A large sample was taken for test purposes. Assay of this gave 17.5 percent manganese, 35.9 percent insoluble, and 11.3 percent ferric oxide.

The main workings are 0.3 mile west of the east workings. Two approximately parallel veins have been uncovered. The northern and principal one, strikes N. 30°-45° W. The southern vein is 75 yards to the southwest and strikes N. 50° W. The northern ore zone has been developed to a vertical depth of 90 feet by an incline which follows the dip of 65° to 70° SW. At 20 feet depth the vein has been followed for 150 feet by a drift which communicates with the surface. This is the haulage level. At the 65-foot level is a 40-foot drift trending S. 45° E., and a 60-foot drift trending N. 32° W., from the incline. Short drifts have been made to the northwest and southeast at the bottom of the incline.

The ore zone consists of masses of black oxide ore, and of irregular veins 1 foot to 4 feet in width in the conglomerate. In the drift at the bottom of the incline is a maximum width of 10 inches of good ore. Nothing was seen here that could be worked profitably. A sample taken across 4 feet of low-grade ore at the end of the northwest drift assayed 16.4 percent manganese, and 60.7 percent insoluble.

The ore above the 65-foot level has been stoped to the 20-foot level for 25 feet to the southeast, and for 40 feet northwest of the incline. The ore body was followed to its end on the southeast, but only 1 foot to 2.5 feet of ore is exposed in the 65-foot level for 20 feet beyond the stoped part. A sample taken across 2 feet of ore at the northwest end of the drift assayed 17.3 percent manganese, and 51.3 percent insoluble. On the 20-foot level northwest of the incline, 2 feet of good ore extends for one-half the distance to the end of the drift. Along the rest of this distance the good ore is from 0.5 foot to 1.5 feet wide. A sample taken across 3 feet of good ore at a point 50 feet northwest of incline assayed 31.4 percent manganese, and 32.7 percent insoluble. The above described workings have furnished most of the ore that has been shipped from this property. The total amount shipped, according to the Tonopah & Tidewater Railroad agent at Ludlow, is 480 tons.

The southern ore zone has been followed for 75 feet along the strike, to a maximum depth of 15 feet below the surface of the ground. Sixty tons of ore, apparently of shipping grade, has been mined and stacked here. From the size of the workings, about 200 tons of ore and waste were removed to obtain the 60 tons of ore.

No. 15. Northrup Prospect. (By R. R. Morse, September 1918.) The Northrup prospect is in sec. 8, T. 8 N., R. 3 E. The claim is said to have been located by a Mr. Northrup. The ore in this claim is reported to be similar in appearance to that of the Black Raven prospect (San Bernardino 6). As the size of the outcrop was described as being "about 6 feet by 10 feet" it was not considered worthy of investigation.

No. 16. Orchard (Dunbar) Deposits. (By Parker D. Trask, August 12, 1942.) The Orchard deposits are about 1 mile west of Lake Havasu, due west of the Thompson deposits which are across the lake in Arizona, 14 miles above the Parker Dam. They are located in sec. 10, T. 3 N., R. 26 E. The owners are Robert Orchard of Glendale, and Charles Dunbar of Parker Dam. An adit 50 feet in length has been driven into the ore body to ascertain its nature at distance from the outcrop. The beds strike north and dip 30° W. They consist of massive fanglomerate more than 100 feet in thickness. Some 40 or 50 feet of this zone is stained black with manganese oxide, which forms fillings around the rock constituents. The fanglomerate is exposed for 1,000 feet along the strike and forms a massive reef. It is offset 50 feet in the middle by a cross fault. The grade of the ore is different on the two sides of the fault. North of the fault it is mostly 5 percent or less, and south of the fault it is chiefly 6 to 8 percent, but in some places it is 10 or 12 percent.

The ore seems to be related to strike fissures that cut the fanglomerate, for the grade is materially different on the two sides of some fissures. However, it is essentially the same on the two sides of others. The ore at first appearance seems to be a bedded deposit, but the difference in degree of mineralization on the two sides of fissures suggests strongly that the ore in part at least is of fissure origin.

No. 17. Owls Spring Prospect. (By C. B. Hunt and Edgar Bowles, 1942.) The Owls Spring deposit is in sec. 18, T. 18 N., R. 3 E., in the Owlshead Mountains, 2 miles west of the Emma deposit (San Bernardino 9). The ownership was not ascertained. The ore body consists of manganese oxide disseminated in bedded deposits, presumably of lacustrine origin. The deposit is 1,000 feet in length and the dip is 40° to 50°. The average grade is less than 10 percent manganese.

No. 18. Reinerth Prospect. (By R. R. Morse, September 23, 1918.) The Reinerth prospect is in the Ludlow district in sec. 5, T. 8 N., R. 8 E. It is located near Milepost 7, on the Tonopah and Tidewater Railroad, 7 miles north of Ludlow, and a few miles northeast of the Lee Yim claims (San Bernardino 10), on the east slope of the Cady Range. The claim is owned by E. A. Reinerth, an official of the railroad company, living in Ludlow.

All the ore in this locality is said to have been removed, furnishing a shipment of 10 tons, sold to the Noble Electric Company, and shipped from Ludlow to Heroult in the latter part of December 1917. The claim was not examined. The ore is similar in character to that of the Lee Yim deposits. The 10-ton shipment was the result of very painstaking hand sorting. The assay returns from the smelter showed a manganese content of 34.7 percent. The owner states that no additional ore is on the claim.

No. 19. Stewart Mine. (By Ivan F. Wilson, March 8, 1943.) The Stewart mine is on the north flank of the Whipple Mountains in the NW¼ sec. 6, T. 3 N., R. 25 E. The nearest rail point is Needles, 41 miles north by road. The ore is hauled to the Metals Reserve depot at Parker, Arizona, a distance of 64.5 miles by road. The mine is reached from the road between Needles and Rose (U. S. Highway 95). A private powerline road turns off to the southeast at a point 27 miles north of Rose and 21 miles south of Needles. This powerline road is followed for 9.4 miles, where another road turns off to the south. This road is followed for an additional 10.8 miles to the mine. The mine is owned by J. W. Stewart, and is leased to the Mineral Materials Company of Alhambra. Five men were working on the property when visited.

In 1942 one carload of 17 tons, containing 35.95 percent manganese, was sent to the Metals Reserve stock pile at Phoenix, Arizona. Two additional carloads fell below 35 percent and were rejected, and it is understood that these were reshipped to the Kaiser plant at Fontana. In 1943, until March 18, 109 tons had been sent to the Metals Reserve depot at Parker, Arizona. The individual shipments ran between 35.84 and 39.66 percent manganese. A composite sample showed the other constituents to be aluminum, 2.61 percent; iron, 2.58 percent; silica, 5.37 percent; zinc, nil; phosphorus, 0.02 percent.

The main ore zone has been developed along three levels, within a small vertical interval. At the surface is an open cut 52 feet long and 15 feet deep; 20 feet below the surface is a tunnel 42 feet long, with a cut 41 feet long at the mouth; at the mouth of the tunnel is a winze 32 feet deep from which another tunnel has been driven for 33 feet. The two tunnels are driven in the direction S. 15° E. Other open cuts and trenches are in the vicinity, and to the east is a crosscut tunnel 25 feet long with a 30-foot cut at the mouth. The above mentioned workings are on the south side of a steep canyon. The level of the main tunnel is 20 feet above the bottom of the canyon. This locality will be referred to as working place No. 1.

Across the canyon and about 1,000 feet farther west at working place No. 2 is another tunnel 20 feet long, with a cut 25 feet long at the mouth, driven N. 65° W. into the slope. About half a mile farther west, near the top of a low ridge on the north side of the canyon, are some other workings, called workings No. 3, including a shaft 18 feet deep and a tunnel 45 feet long trending N. 40° W. from the bottom of the shaft.

The deposits consist of fissure zones in fanglomerate impregnated with manganese oxide. The main fissure at working place No. 1 has a smooth footwall and a gradational hanging wall. It strikes N. 10°-15° W. and dips 65° to 70° W. The wall rock is a poorly sorted, well indurated sedimentary breccia, containing angular to subangular fragments 1 inch to 6 inches in diameter in a red to orange, sandy, and clayey matrix. The fragments are chiefly of granitic and metamorphic rocks, sandstone, and a few volcanic rocks. The fanglomerate strikes N. 80° W., and dips 10° S.

Zones of varying width adjacent to the fissures are cemented, impregnated, and partly replaced by manganese oxide. The manganese oxide is mainly a soft, black crystalline mineral—probably pyrolusite. Some hard botryoidal material of the psilomelane type is also present, but the soft oxide is more prevalent than in most of the fissure deposits of southeastern California. Brown calcite, probably manganiferous, occurs in many places and it seems likely that this may be the primary ore. In the crosscut tunnel at working place No. 1 a vein of nearly solid brown carbonate, 2.5 feet wide, occurs. It is cut by veinlets of white calcite which appear to be later in origin. The brown calcite is within 5 to 10 feet of the surface in places. Hematite and limonite also accompany the manganese oxide, and appear to increase in proportion with depth below the surface.

The general run of the ore is low grade, probably between 15 and 25 percent manganese. The impurities are wall rock, calcite, hematite, and limonite. It has been extremely difficult to sort out a product containing as much as 35 percent manganese. In the process a large amount of low-grade ore has been mined and rejected on the dumps. This material probably could be sold to the Kaiser plant at Fontana, but the operators were doubtful whether the price received would pay for the cost of transportation and loading at the mine.

No. 20. Turner Prospect. (From files of U. S. Geological Survey, 1918.) A deposit said to be owned by M. C. Turner is located a few miles south of Newberry, in T. 8 N., R. 3 E., presumably in sec. 9. No other information is available.

No. 21. Vivian Prospect. (From files of U. S. Geological Survey, 1918.) A deposit said to be owned by Al Vivian is in T. 3 N., R. 5 E., some 10 miles northeast of Palm Springs. No other information is available.

SAN DIEGO COUNTY

No. 1. Clark Prospect. (By F. S. Hudson, May 16, 1918.) W. S. Clark of Fallbrook, owns two claims in T. 9 S., R. 2 W. In the SE¼NW¼ sec. 18, at an altitude of 1,620 feet, a pit exposes granite impregnated with black oxide of manganese. The prospect of finding ore of commercial grade is extremely poor. An open cut in the SE¼SW¼ sec. 7, exposes an aplite dike within which manganese occurs as dark brown stains. The ore is of low grade. Local report credits one of the Clark claims with ore carrying 18 percent manganese. Nothing was seen at either claim that would carry over 5 percent manganese.

No. 2. Del Monte Prospect. (By Spangler Ricker, March 1941.) A deposit said to be owned by M. J. Flynn of San Ysidro is located 4 miles northeast of Jacumba in T. 17 S., R. 8 E. The ore body consists of manganese oxides in a shear zone in granite. The ore is exposed for a distance of 20 feet and has an average width of 2 feet. A representative sample assayed 14.5 percent manganese, 3.3 percent iron, and 65.6 percent silica. The property has not been developed.

No. 3. Engineer's Springs. (By F. S. Hudson, June 13, 1918.) According to the State Division of Mines report on San Diego County,[1] a lens of banded red and white jasper occurs in black shale in sec. 22, T. 18 S., R. 2 E., south of Dulzura. Quartzite and granite are also said to occur there. As Franciscan rocks have not yet been reported from this area, and as any chert locality is a possible source of manganese, the writer spent several hours in examination of this section. No jasper, black shale, or quartzite was found. The predominating rock is rhyolite, which under the hand lens is seen to consist of small blebs of quartz and crystals of plagioclase in a fine-grained felsitic matrix. Much of the rhyolite is "sheeted" and resembles, in the outcrop, either quartzite or chert. At several prospect pits in the rhyolite, the rock is bleached white, sericitized, and often stained red with iron oxide. This red stain frequently occurs in concentric bands.

Dr. C. C. Valle of San Diego, who owns this property, showed the writer several polished sections of jaspillite or jasperoid alteration of rhyolite. These are siliceous, and the high polish exhibits the iron stained bands to good advantage. The prospect of finding manganese in bedded deposits of the Coast Range type in the country south of Dulzura is evidently quite poor. As far as could be ascertained, no manganese of any type has been found here.

No. 4. Jacumba Group. (Modified slightly from original description in California Min. Bur. Rept. 20, p. 374, 1924; and in California Div. Mines Rept. 35, p. 30, 1939.) The Jacumba group of claims is 1 mile northwest of Jacumba in secs. 5 and 6, T. 18 S., R. 8 E., at an altitude of 2,900 feet. Eight claims have been located by B. F. Stanwood and J. J. Curl of San Diego. A number of silicified outcrops, with general northwest strike, occur in the granite. At several places these outcrops are heavily stained with manganese oxides. Analysis of ore extracted from different prospect holes is reported as manganese, 7 to 22 percent; iron, 14 percent; silica, 16 to 25 percent. Only assessment work has been done on the claims.

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[1] Trask, Parker D., Wilson, Ivan F., and Simons, Frank S., Manganese deposits of California: California Div. Mines Bull. 125, pp. 85, 165, 1943.

Another group of claims is located 1 mile northwest of Jacumba, in secs. 5 and 6, T. 18 S., R. 8 E. They are owned by Dr. M. C. Harding of San Diego. Occurring on this property is a 4-foot vein of a low-grade manganiferous iron, with a high silica content. Two shallow test pits have been put down, revealing the ore in place.

No. 5. Machado Prospect. (By F. S. Hudson, May 16, 1918.) The Machado prospect is 5 miles south of Temecula in the SW¼NW¼ sec. 6, T. 9 S., R. 2 W. It formerly was owned by George Daly, but it is now the property of M. Machado of Temecula. The ore body consists of a manganese-stained zone in a mass of pegmatite and aplite, which strikes N. 70° W., along the course of the hill. No definite veining was seen, and not over 50 pounds of ore was visible. The prospect is not promising.

No. 6. Ramrod Prospect. (From files of U. S. Geological Survey, 1941.) A deposit owned by V. W. Deaver is situated near Jacumba in T. 18 S., R. 8 E. It is said to be of little value.

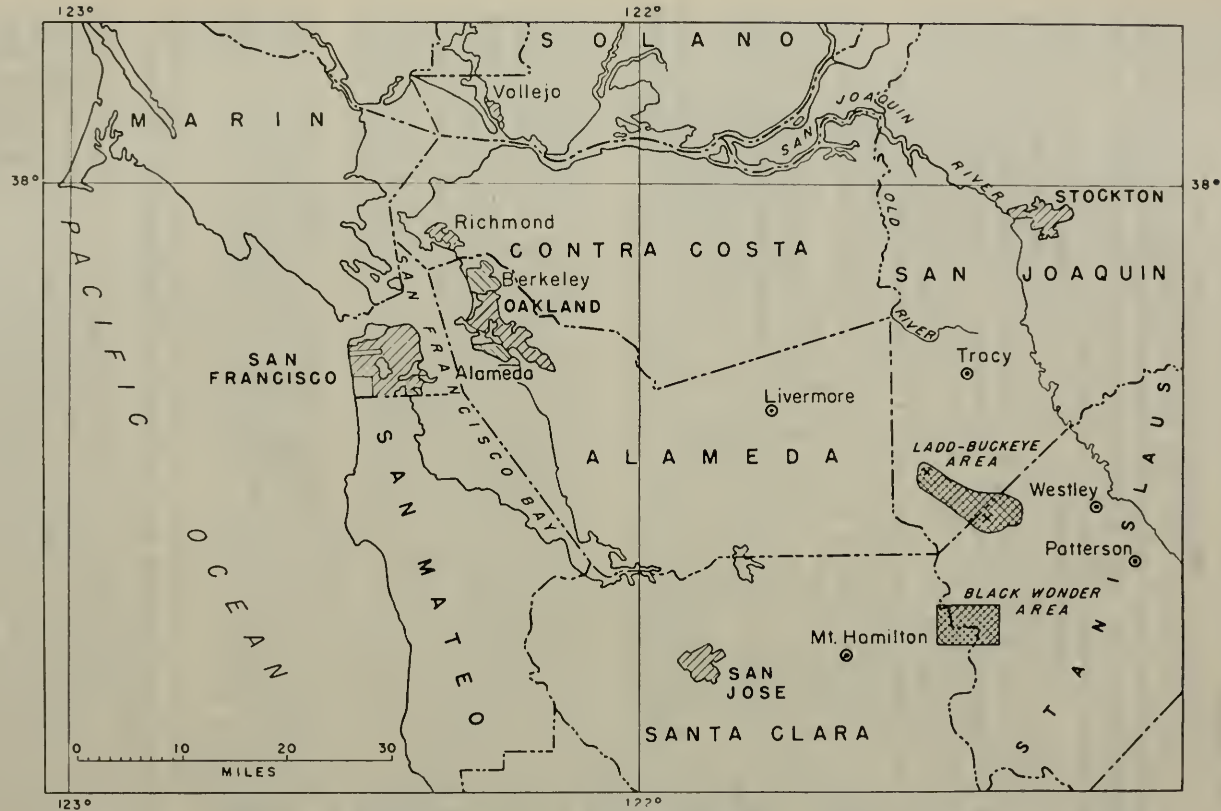
No. 7. Ruby Prospect. (By F. S. Hudson, June 12, 1918.) A prospect for manganese, the property of D. A. Ruby of Boulevard, San Diego County, is 2 miles southeast of a point on the San Diego-Imperial Valley Highway, 3 miles southeast of Boulevard. It is said to be in sec. 16, T. 18 S., R. 8 E. The ore-bearing material is a bed of siliceous manganese ore enclosed in quartz-mica schist. The strike is N. 60° W., the dip is north at a high angle. The schist occurs as a body less than 50 feet thick, in granite.

The ore bed is 7.5 feet thick. The lower 5 feet is gray quartzite with bands of pink and brown, siliceous manganese ore. Some of the fine-grained gray quartzite is clearly derived from chert, and for this reason all the quartzitic material is thought to represent a metamorphosed chert. North of this more siliceous portion is 1.5 feet of nearly pure, pink manganese silicate, beyond which is 1 foot of oxidized ore of good grade. Manganese garnet crystals up to half an inch in size occur at about the middle of the quartzose bed. Garnet crystals of microscopic size together with a few rhodonite crystals were identified in a thin section of the fine-grained, gray metachert.

A winze has been sunk along the oxidized part of the ore body. This body decreases in thickness rapidly with depth. A narrow pegmatite stringer, which is seen in the hanging-wall schist at the top of the winze, increases in width with depth and appears to ''cut out'' a portion of the ore body.

The deposit is thought to be due to the contact-metamorphic action of pegmatite and granite on a bed of siliceous manganese carbonate or carbonate-oxide ore.

No. 8. Sunrise Mine. (Modified slightly from original description in California Div. Mines Rept. 35, p. 30, 1939.) The Sunrise Mine is owned by Calvin W. Garrison of San Diego, and is located in sec. 10, T. 13 S., R. 5 E., about 9 miles east and north of Banner. A 5-foot vein of manganese oxide occurs on this property, carrying gold. The property has been developed by 2 tunnels, one 8 feet in length, and the other 50 feet. It is now idle.


123°
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SOLANO
Vollejo
MARIN
JOAQUIN
SAN
RIVER
STOCKTON
OLD
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Richmond
CONTRA COSTA
SAN JOAQUIN
Berkeley
OAKLAND
SAN FRANCISCO
Alameda
SAN FRANCISCO BAY
Tracy
Livermore
PACIFIC
OCEAN
ALAMEDA
LADD-BUCKEYE AREA
Westley
Patterson
STANISLAUS
SAN MATEO
BLACK WONDER AREA
Mt. Hamilton
SAN JOSE
SANTA CLARA
0
10
20
30
MILES

FIGURE 5. Index map of the Ladd-Buckeye and Black Wonder areas, San Joaquin, Santa Clara, and Stanislaus Counties, California.

No. 9. Turner Prospect. (By F. S. Hudson, June 11, 1918.) The Turner prospect is on a claim owned by J. C. Turner of San Diego. It is in the SE¼NE¼ sec. 31, T. 14 S., R. 5 E., on a gulch which drains to Deer Park about 0.8 mile to the southwest. The ore bed is a banded siliceous rock of blue-gray color. The fine-grained parts indicate their derivation from chert, but the greater part of the material is a medium-grained, iron-stained quartzite. Veinlike masses of white quartz cut the quartzite. Numerous fractures in the quartzite are coated with manganese oxide; a few fairly large pieces on the dump may carry as much as 5 percent manganese. This quartzite occurs as a lens 5 feet thick inclosed in "gnarly" quartz-mica schist. About 300 yards to the southwest, light-colored gneiss was seen, probably intrusive into the schist. In the NE¼SW¼ sec. 31, a basic or intermediate plutonic rock is exposed. Nothing was seen here that would encourage further prospecting for manganese.

SAN JOAQUIN COUNTY

Geology of the Ladd-Buckeye Area[1]

General Features. An area 12 miles long and 2 to 4 miles wide in the southwest part of San Joaquin County and the northwest part of Stanislaus County between the Ladd mine on the north and the Buckeye mine on the south, has produced more manganese than any other district of like dimensions in California. The location is shown in figure 5. Prior to World War II this area produced 50,000 tons of manganese ore, approximately 50 percent of the total production in the state up to that time. During World War II it yielded more than 13,000 tons, or more than 25 percent of the production from the state during that period. The ore has come principally from five deposits. The Ladd mine (San Joaquin 5) has produced approximately 30,000 tons, all prior to the termination of World War I. The Buckeye mine (Stanislaus 4) yielded 15,000 tons before World War II, and more than 11,000 tons during World War II. The Cummings (San Joaquin 3) and Liberty (Stanislaus 16) mines each produced more than 2,000 tons, mostly prior to World War II; and the Mahoney mine (San Joaquin 6) more than 1,500 tons during World War II.

The U. S. Geological Survey began a detailed study of this district in 1940, when the imminence of war stimulated search for domestic supplies of manganese. The region was particularly favorable for investigation because it is one of the few places in California where the structure of the Franciscan group, the principal host of manganese in the Coast Ranges, is relatively simple. In the study of this area, special attention was given to the mode of origin of the manganese deposits, in order to develop geologic criteria which would facilitate the prospecting and development of manganese deposits in the Franciscan.

The field work was carried on by D. C. Cox, S. C. Creasey, F. Hoyt, S. G. Lasky, John Nelson, H. P. Norbeck, W. G. Pierce, F. S. Simons, A. F. Shride, P. D. Trask, F. D. Trauger, C. R. Warren, and I. F. Wilson. Lasky was in charge of the field party from July 1940 to May 1941, and Trask the remainder of the time.

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[1] By Parker D. Trask and W. G. Pierce.

The areal geology was mapped on airplane photographs made by the Agricultural Adjustment Administration. The photographs were enlarged two diameters to a scale of approximately 1 to 10,000. The geology was compiled on a scale of 1 to 12,000 on a topographic base map made from airplane photographs by means of a stereo-comparagraph, supplemented by appropriate field triangulation (pl. 4). The topographic base map was made by W. G. Pierce, A. F. Shride, and F. D. Trauger.

The U. S. Bureau of Mines explored the deposits at the Ladd and Buckeye mines between August 1940 and June 1941. M. E. Volin was in charge of this work. The Bureau opened up the adits, drove several crosscuts, sampled extensively, and sank 15 drill holes—five at the Ladd mine, six at the Fabian mine 2,000 feet north of the Ladd mine, and four at the Buckeye mine. The estimates of grade and reserves of the Ladd mine are based on assay data supplied by the Bureau of Mines.

The area is in rugged country, ranging in altitude from 600 to 3,000 feet. The four main streams, Corral Hollow, Lone Tree, Hospital, and Ingram Creeks, carry water throughout most of the year but the tributaries are dry during the latter part of the summer. The five principal mines are accessible by roads. The distances to the nearest railroad from these mines are as follows: Ladd mine, 7 miles to the Western Pacific Railroad at the gravel pits at the mouth of Corral Hollow, and 13 miles to the Southern Pacific Railroad at Tracy; Mahoney mine, 8 and 12 miles, respectively, to these points; Cummings mine, 13 and 17 miles, respectively to these same points; and Buckeye and Liberty mines, 16 miles to the Southern Pacific Railroad at Vernalis.

An account of the general geology of the region is given by Anderson and Pack.[2] A detailed description of the geology of the Tesla quadrangle which adjoins the Carbona quadrangle on the west, is given by Huey.[3] General discussions of the sandstone and chert of the Franciscan, have been written by Davis.[4]

The manganese deposits are in the Franciscan group of Jurassic (?) age, and the geologic mapping was confined almost entirely to this formation (pl. 4). The Franciscan rocks are bounded on the northeast by the Tesla and Lone Tree faults, which bring the formation into contact with the San Pablo (Miocene) formation in the north part of the area, and with the Panoche (Upper Cretaceous) and Horsetown (Lower Cretaceous) elsewhere. Recent and Pleistocene landslides are found throughout the area; and in places of gentle slope a mantle of alluvium commonly blankets the land to depths of 1 foot to 20 feet.

Franciscan Group. The Franciscan in the Ladd-Buckeye area includes a wide variety of rocks: sandstone, chert, shale, conglomerate, limestone, greenstone (altered basalt and andesite), diabase, granophyre, diorite, gabbro, serpentinized peridotite, phyllite, marble, glaucophane schist, and related schists. The thickness of the formation in the area mapped is more than 10,000 feet. The base of the formation is not exposed.

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[2] Anderson, Robert, and Pack, R. W., Geology and oil resources of the west border of the San Joaquin Valley north of Coalinga, California: U. S. Geol. Survey Bull. 603, 1915.

[3] Huey A., Geology of the Tesla quadrangle, California: California Div. Mines Bull. 140, 75 pp., 1948.

[4] Davis, E. F., The Franciscan sandstone: Univ. California, Dept. Geol. Sci. Bull. 11, pp 1-44, 1918 . . . The radiolarian chert of the Franciscan group: Univ. California, Dept. Geol. Sci. Bull. 11, pp. 235-432, 1918.

The Franciscan group consists predominantly of sandstone and shale. Conglomerate occurs in only a few lenses less than 25 feet thick. Limestone is also present in a few places. The sandstone is found mainly in massive beds separated by thin shale beds. It is feldspathic and contains numerous fragments of hardened mud or shale flakes up to an inch in diameter. In contrast with the sandstone of younger formations, particularly with the Cretaceous sandstone which it superficially resembles, the sandstone of the Franciscan is relatively rich in fragments of dark (ferromagnesian) minerals and relatively poor in mica. The shale is mostly in thin beds less than 6 inches thick, but in places is 50 to 100 feet thick. West of the Ladd mine the shale is locally altered into phyllite. The color of the shale is gray, red, or chocolate brown. In places the shale grades laterally into chert.

The chert is found in lenses which range in size from small nodules an inch in length and 0.2 inch in thickness to bodies more than 1,000 feet in thickness and 3 miles long. The lenses commonly vary greatly in thickness within short distances. Rates of increase in thickness of 1 foot for each foot of length, have been observed.

The chert is of two types: (1) red or chocolate-brown chert, in beds 1 inch to 6 inches thick separated by shale beds of similar color, 0.05 inch to 2 inches thick; and (2) white, light-gray, or pale-green chert either in alternating layers with shale, similar to the first type, or in massive beds. Most of the massive beds are 5 to 10 feet thick, but some beds are 40 feet thick. In many places the chert contains small pale round objects which are the remains of radiolaria. These radiolaria seemingly are of marine origin.[5]

Detailed mapping of the individual chert beds (pl. 4) shows that they are interbedded in sandstone and shale. Some of the chert bodies are lenses in the clastic rocks; others grade imperceptibly into sandstone or shale along the strike; and still others interfinger or feather out in the sandstone or shale. In one place in Sulphur Gulch on the east side of Hospital Canyon, the chert grades into sandstone through an intermediate zone in which the chert contained a multitude of loosely disseminated sand grains. In this intermediate zone, the grains seem to have been suspended in a jellylike mass, which subsequently consolidated.

The chert beds and lenses are found in two main zones, one near the Ladd mine and the other near the Buckeye mine. These zones seem to be at essentially the same stratigraphic position. Near the Ladd mine, chert is found through a zone 4,000 feet in thickness; and at the Buckeye mine, through a zone nearly 10,000 feet in thickness. Between these two mines the individual chert bodies are notably thinner, and the zone in which they occur likewise is materially thinner than at the mines themselves. For a distance of 3 miles between Hospital and Lone Tree Creeks the chert is restricted to a zone less than 1,000 feet thick, and only a few thin chert beds are present. The change in thickness of the chert layers and of the stratigraphic zone in which they are found is conspicuous west of the Buckeye mine. Within a distance of slightly more than 2 miles this zone changes from 10,000 to 1,000 feet in thickness. The individual chert beds converge to the west like ribs of a fan. Their mappable continuity rules out the possibility that the decrease is the result of faulting.

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[5] Davis, E. F., The radiolarian chert of the Franciscan group: Univ. California, Dept. Geol. Sci. Bull. 11, pp. 353-401, 1918.

The chert in places forms massive reefs. Some of these reefs extend for a few hundred feet and then gradually diminish in size; others end abruptly and seemingly pass into relatively soft red or white chert. A few masses of chert have been recrystallized and transformed into glaucophane schist and related schist. These reeflike masses may represent hydrothermally altered chert.

The Franciscan group in the Ladd-Buckeye region contains fewer igneous rocks than in most other regions. Only three large bodies are present. (1) An irregular body of greenstone, in places parallel to the bedding, is near the Cummings (San Joaquin 3) mine. (2) A sill-like mass of basic igneous rocks lies between the Lone Tree and Tesla faults northwest of Lone Tree Canyon. This mass grades from granophyre at the top down through greenstone, diorite, gabbro, to peridotite at the base. In places it is cut by diabase. (3) A mass of greenstone and granophyre is found near the top of the Franciscan near Hospital Creek. A few small outcrops of diabase and greenstone occur in other places. The greenstone is an altered dacite or andesite, and the granophyre is a fine-grained crystalline rock, which in places contains quartz crystals. About 10 miles south of the Ladd-Buckeye area, the Franciscan contains a large mass of basic plutonic rocks.[6]

On the north side of Sulphur Spring Gulch, about 1 mile south of the Cummings mine (San Joaquin 3), a plug of greenstone protrudes through the strata. The internal structure of this mass of lava resembles pillow lava, a feature ordinarily regarded as being formed by submarine lava flows, but as the greenstone is discordant with the country rock, the mass of greenstone seems to be intrusive. Perhaps the mass has been squeezed differentially through less competent clastic rocks, and is now at a distance from the strata into which it was originally emplaced; the process possibly being somewhat analagous to the emplacement of salt domes. This differential squeezing of more competent bodies through less competent aggregates of rock, may be more common in the Franciscan than has been generally recognized in the past. Such an explanation might account for some of the many isolated blocks of massive rocks, 10 to 100 feet or more in diameter, which form prominent features of the landscape in areas of Franciscan rocks.

The sandstone, shale, and chert locally have been metamorphosed to crystalline schist. The types of schist that are present include glaucophane, quartz-albite, actinolite, lawsonite chlorite, muscovite, garnet, acmite, and tremolite schist. The schist is found in aureoles, commonly near serpentine. Most of the aureoles are a few feet to a few tens of feet in length. Near the Ladd mine, phyllite has been formed from shale. The time of formation of the glaucophane schist and related schist, and of the quartz and calcite veins, apparently was Jurassic, as no younger rocks contain them.

In places both chert and sandstone are cut by quartz veins. This quartz veining is most noticeable in chert, in which it commonly forms a network of veins from an eighth to half an inch in diameter. Also, much of the primary manganese ore is cut by similar veins. The greenstone commonly is cut by many calcite veins as much as 4 inches in thickness. Marble, showing crystalline faces up to a quarter of an inch in diameter is found in a few places in the Franciscan group, notably in the Ingram Canyon area. The marble is banded and seems to be of vein origin. In the Ladd mine the rhodochrosite is cut by calcite veins.

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[6] Wells, F. G., Hawkes, H. E., and Wheeler, D. P., Chromite and quicksilver deposits of the Del Puerto area, Stanislaus County, California: U. S. Geol. Survey Bull. 936-D, pp. 79-110, 1942.

Horsetown Formation. In the vicinity of Hospital Canyon the Horsetown formation of Lower Cretaceous age overlies the Franciscan group. A thin sandy limestone or calcareous sandstone 50 to 200 feet above the contact carries an ammonite *Sonneratia* which, according to a personal communication from R. W. Imlay, is characteristic of the upper half of the Horsetown formation. This fossiliferous zone closely parallels the contact with the Franciscan, which suggests that the contact is depositional, and the abrupt change in lithology points to the presence of an unconformity. The Horsetown formation consists of soft sandstone and shale. Along Hospital Canyon it is about 4,000 feet thick, for the first Upper Cretaceous fossils are found 4,000 feet above the base of the formation in the matrix of a conglomerate.

Panoche Formation. The Panoche formation of Upper Cretaceous age consists of sandstone and shale very similar to that of the underlying Horsetown. The Panoche was not mapped in detail. The formation is more than 5,000 feet thick; it rests against the Franciscan group by fault contact northwest of Lone Tree Creek; and in the narrow belt mapped northeast of the Tesla fault, it is overlain by the San Pablo formation of upper Miocene age.

San Pablo Formation. The San Pablo formation consists predominantly of sandstone. The sand grains in some beds are coated with a bluish material said to be the phosphate mineral vivianite, which imparts a distinctive color to the rocks.

Quaternary Sediments. The Quaternary deposits consist of landslide debris and alluvium. All the formations in the Ladd-Buckeye area give rise to landslides. The more prominent landslides have been shown on plate 4. Some of the landslides are clearly related to earlier erosion cycles, and are now dissected materially. The rocks in some areas of moderate and gentle relief are overlain by a mantle of alluvium and rubble which attains a maximum thickness of 20 feet. This alluvial material contains many rock fragments that range in size up to 6 inches. The alluvium seemingly was deposited in an earlier cycle of erosion when the relief of the land was less than at present. This alluvium does not erode easily and much of it still persists, even though the main drainage lines are considerably below it. In places, particularly around the Ladd mine, it blankets parts of the country so effectively that the nature of the underlying rocks cannot be determined.

Structural Features. The Franciscan group has been severely deformed. It stands in steeply inclined beds and is tightly folded in many places. Few distinctive stratigraphic zones or key beds of value for field tracing were found in the area. Consequently structural interpretations must be made from the areal pattern of the lithologic units and the apparent dip of the beds. The problem is complicated further by uncertainty as to whether the strata are right side up or are overturned.

The prevailing strike is west and northwest. The dip is generally 50° or more northeast, except near the Ladd mine where the dip is west (sec. AA', pl. 4). The rocks in the Ladd area could represent either the northeast limb of the syncline or a section of beds overturned near the Tesla fault. If the beds are not overturned, they probably are on the northeast limb of the syncline mapped east of the Cummings mine. If this interpretation is true, the ore beds in the Ladd and Cummings mines are essentially at the same stratigraphic horizon.

Two large faults, the Tesla and Lone Tree, extend for a long distance in the east part of the Ladd-Buckeye area. The Tesla fault forms the boundary between the Franciscan group and younger formations. East of Hospital Creek where the trace of the fault lies near the fossil bed in the lower part of the Panoche formation, the displacement seemingly is small, but in the north part of the area the displacement apparently is a few thousand feet. The dip of the fault plane where exposed, ranges from 60° SW. to vertical. As the southwest side is the upthrown side, the fault is a thrust fault.

The Lone Tree fault is later than the Tesla fault. In the vicinity of Lone Tree Creek the trace of the Tesla fault is offset 1,500 feet horizontally by the Lone Tree fault. The Lone Tree fault has been traced more or less definitely for 9 miles from a point 2 miles north of Lone Tree Creek to the east end of the area mapped. The fault plane, where exposed, dips 60° SW. As the upthrown side is on the west, this fault also is probably a thrust fault. The offset of the Tesla fault indicates that a considerable horizontal component may be present. The displacement seems to be a few thousand feet. The traces of the Tesla and Lone Tree faults are bent toward the north near Hospital Canyon, which may indicate deformation after the two faults were formed.

The Franciscan rocks are much crumpled and broken by faults of small displacement, but careful mapping failed to reveal any major faults other than the Lone Tree and Tesla faults. Although the chert is intricately contorted, especially where it is thin-bedded, many individual chert zones were traced for hundreds or even thousands of feet without being offset materially by faults. The only area in which the Franciscan rocks seem to have been seriously broken by small faults is in Ingram Canyon near the Grummett Knox mine (Stanislaus 11). In this area the structure is more complex than shown on plate 4. To a lesser extent the local structure elsewhere is more complex than can be represented on the map.

Many of the small faults in the chert bodies are compression and tear faults. They start with small displacement and within a horizontal distance of 50 to 200 feet build up a displacement of 25 to 50 feet. The compression fault may end in a tear fault or it may continue with diminishing displacement until it merges with the bedding. The chert commonly is interbedded with thin beds of shale, which seem to act as zones of lubrication when the beds are deformed. Normally the chert beds slip over the intervening shale beds without much deformation, but in places local irregularities such as contortions in the chert apparently have impeded slipping along the shale beds, with the result that a break formed and the rocks were pushed over and between adjacent beds for a short distance. Apparently the rocks reacted to structural deformation as incompetent beds, because all the faults are of short horizontal extent and the displacement is small. In the Cummings mine (San Joaquin 3) the deformation came in distinct steps, because in one place two small offsets were formed one after the other, rather than as one larger offset. The generally small displacement of these faults is advantageous to the miner because it lessens the amount of exploration required to find the continuation of ore beds when the ore is truncated by faulting.

Physiography. The Ladd-Buckeye region contains evidence of several cycles of erosion. The tops of the hills are rounded and gently sloping, suggestive of the remnants of an elevated surface of low relief. Benches and terraces on the sides of the valleys point to uplift in steps.

Ore Deposits. The manganese deposits in the Ladd-Buckeye area are found exclusively in white chert. The white chert is in two zones of thin-bedded and massive chert, one near the Ladd mine at the north end of the area mapped, and the other near the Buckeye mine, 8 miles to the south (pl. 4). The interval between these two zones contains relatively little chert and no worthwhile manganese deposits. The distribution of the chert strongly suggests that the ore zones at the Ladd (San Joaquin 5), Cummings (San Joaquin 3), Buckeye (Stanislaus 4), and Tip Top (Stanislaus 28) mines are at essentially the same stratigraphic horizon. The Liberty and Moran Brothers mines (Stanislaus 16 and 21) seem to be 3,000 feet stratigraphically above this horizon.

The stratigraphic thickness of the ore zones exhibits a crude relationship to the thickness of the chert zones which contain the manganese. At the Cummings mine the ore is found in a stratigraphic zone 65 feet thick and the chert in which this zone lies is 300 feet thick. The respective thickness of the ore zone and the chert section for the Ladd mine are 125 and 600 feet, and for the Buckeye and Tip Top mines approximately 600 and 2,000 feet, respectively; that is, the ratio of the ore zone to thickness of chert in these four mines is of the same order of magnitude, which suggests a genetic relationship between the manganese and chert.

The manganese ore forms beds of lenses in bodies of massive white chert, which in turn are lenticular. The ore lenses are roughly elliptical in outline. The general dimensions of the ore beds that have been mined sufficiently to indicate their form are given in the accompanying table. The ore bodies range in length from a few feet to 800 feet, but most of them are less than 200 feet in length. The ratio of maximum diameter to minimum diameter ranges chiefly between 1.3 and 2. The maximum thickness of the mined ore bodies ranges mainly between 4 and 10 feet; the maximum thickness of 35 feet at the Ladd mine includes some disseminated ore, which has not been mined. The thickness of the deposits is small compared with their length. The ratio of length (greatest diameter) to maximum thickness ranges mainly between 15 and 40.

Types of Ore. Two types of ore are found: (1) massive ore, and (2) disseminated ore. The principal primary mineral in the massive ore is fine-grained gray rhodochrosite, having an average grain size of about 0.05 inch, and in the disseminated type it is a mixture of rhodochrosite and bementite (hydrous manganese silicate) disseminated in chert. Some bementite is found in the massive type of ore, commonly in laminae alternating with carbonate. Both kinds of ore are cut by numerous intersecting veins of quartz and pink rhodochrosite 0.05 to 0.25 inch in thickness. In a few places the massive gray rhodochrosite is cut by small calcite veins. Hausmannite, rhodonite, and braunite have been reported from the massive ore beds, but they are not plentiful. Near the surface of the ground, the ore is oxidized to the usual black oxides.

The zone of gradation between massive rhodochrosite and wall rock in most deposits is relatively thin, both on the sides and at the ends of the ore bodies. The material in this transition zone consists of rhodochrosite and bementite disseminated in chert. In places near the ends or edges of the ore zones, the massive ore gives way gradually to disseminated ore throughout a distance of several feet.

Most ore bodies are blunt and tongue shaped at their ends, though some of them grade into the wall rock in an interfingering pattern in which much bementite is mixed with the chert. In such transition zones, rhodochrosite is commonly found in spherules and rhombs which have a maximum diameter of a quarter of an inch.

The east ore bed at the Ladd mine contains a thick zone of disseminated ore above the massive ore. The massive ore ranges in thickness from 2 to 15 feet and the disseminated ore from 1 foot to 30 feet. The grade of ore decreases more or less regularly upward in the deposit.

The manganese oxide in the massive ore bodies is similar to the oxide ore in the disseminated ore beds, although in the massive beds the oxide ore commonly is hard and dense; whereas in the disseminated type much of it is soft and powdery, presumably because of its disseminated nature. The manganese in general has not migrated far from its original position, and little ore is found in the wall rocks except for films along fractures.

Table 4. Range in size of manganese ore bodies in the Ladd-Buckeye and Black Wonder areas, San Joaquin, Santa Clara, and Stanislaus Counties.

Name of ore bed	Maximum diameter (feet)	Minimum diameter (feet)	Maximum thickness (feet)	Ratio of maximum to minimum diameter	Ratio of maximum diameter to maximum thickness
Ladd mine (San Joaquin 5)					
East ore bed	800	350+	35	2.2	23
West ore bed	170	100	4	2.3	43
Cummings mine (San Joaquin 3)					
North ore bed	150	85	10	1.8	15
Middle ore bed	150?	75?	4	2.0?	37?
South ore bed	75?	50?	4.5	1.5	17?
Buckeye mine (Stanislaus 4)					
North ore bed	220	200+	11	1.1	20
South ore bed	125	100	9	1.3	14
Liberty mine (Stanislaus 16)					
Ore body A	175	75	8	2.3	22
Ore body B	110	35	3	3.0	37
Ore body C	40	20	3	2.0	13
Jones mine (Santa Clara 19)	150	110	5	1.4	30
Murmac (Santa Clara 34)	100	50	2.5	2.0	40
Average (median)	150	80	5	1.9	23

Manganese carbonate and bementite oxidize readily to manganese oxides. The chert at the surface of the ground commonly is silicified and the ore is hard and dense, but within a few feet of the surface the chert is leached. The ore in these leached zones commonly is soft and porous and easily removed with a pick. In places the silica has been largely dissolved from the wall rocks, leaving a clayey residue.

The depth of oxidation in part seems to be related to the ruggedness of the topography. In the Ladd, Cummings, and Liberty mines, which are located near the crests of rounded hills, the zone of oxidation is more than 100 feet in depth; however, in the Buckeye mine situated on the side of a steep valley, it is less than 100 feet in depth. At the Acme lode prospect (Santa Clara 1) in the floor of Beauregarde Creek in the Black Wonder area 15 miles south of the Buckeye mine, rhodochrosite is found within 1 foot of the surface of the ground. Consequently, in appraising reserves of ore in undeveloped prospects one should bear in mind that the ore may pass into primary carbonate and bementite within a relatively short distance if the deposits are located on the sides or in the bottom of canyons.

The original manganese carbonate in places has been altered by hydrothermal solutions, as is attested by the quartz veins that cut it; by the presence of small amounts of cinnabar in the ore at a few places, notably in the Liberty mine and the north ore body at the Buckeye mine; and by the lack of bedding and uniform grain size of the massive gray rhodochrosite. The presence of hausmannite, rhodonite, and braunite also suggests hydrothermal alteration. The hydrothermal action, however, probably has not caused the manganese to migrate far, because all of the deposits that were seen are essentially parallel to the bedding and hence seem sedimentary in origin.

Grade of Ore. The grade of the massive ore is fairly high. The beds of primary carbonate commonly contain from 35 to 42 percent manganese, and 10 to 15 percent silica. The oxides derived from such deposits by weathering have from 50 to 55 percent manganese, and from 10 to 20 percent silica. The banded bementite and carbonate deposits have from 25 to 35 percent manganese, and from 15 to 30 percent silica. The disseminated deposits have from 5 to 25 percent manganese, and from 30 to 60 percent silica. Thus, manganese and silica vary inversely with each other. Except for silica, the ore contains no undesirable impurities. Iron ranges mainly between 0.5 and 1.5 percent, phosphorus between 0.02 and 0.06 percent, and sulphur between 0.01 percent and 0.03 percent.

Origin. The origin of the manganese deposits is intimately associated with the deposition of the chert. No ore body in the Ladd-Buckeye area is found in rocks other than white chert. In Humboldt County in northern California, manganese in places is found in alternating red shale and chert in the Franciscan group. In the Ladd-Buckeye region some of the massive white beds contain ore that grades laterally into thin-bedded white and red chert within a distance of a few hundred feet, but the ore invariably is associated with the white chert, and in most places with massive white chert.

The stratigraphic distribution of the chert suggests that the chert beds are laid down in basins on the sea floor. The way in which the zones of chert and associated sediments pinch and swell along the strike and their lenslike shape, supports such a concept. Moreover, many of the beds of white chert in which the rhodochrosite is found, are included in zones of red chert, which in turn are lenticular masses in sandstone and shale. The red color of the chert suggests an advanced state of oxidation, and the presence of manganese carbonate indicates a state of retarded oxidation, or more appropriately a state of relative reduction. Manganese in the form of rhodochrosite is in the lowest oxidized state for manganese.

A progressive deoxidation of the sediments from red chert to manganese carbonate, therefore, is suggested. A favorable place for the development of a state of reduction is in basins on the sea floor, where the water is relatively deficient in oxygen. Sediments in basins are deposited under more reduced conditions than sediments that accumulate in adjacent shallower parts of the sea.[7] The lack of higher oxides in manganiferous white chert accordingly suggests deposition in basins.

A zonal relation of manganese, white chert, and red chert is not observed for all chert bodies, particularly transverse to the bedding; but commonly along the strike, the beds change successively from sandstone or shale to red chert, white chert, manganiferous chert and then back again through white chert, red chert to shale and sandstone. In places the manganiferous phase is not present and in other places even the white chert is absent. Also, in still other places red chert, white chert, and shale are intimately interbedded. Consequently, the distribution of the different kinds of chert is not regular enough to be regarded as conclusive evidence of deposition in basins.

An indirect line of evidence that points to the existence of basins is as follows: In order for either chert or manganese to accumulate in the sea, some trap or means of precipitation must be present; otherwise the circulation of the ocean water would take the manganese and silica out to sea, where they would be disseminated in the vast volume of ocean water. Basins have thresholds above which the overlying water tends to flow. The main means by which the water and dissolved solids or suspended particles below the rim of the basins can be transported out of the basins is by convection and turbulence, which are relatively slow processes in the deep parts of the sea. Consequently, if a basin received a supply of silica and manganese from submarine springs or lava flows, or from ash deposits upon land, or any other source, that part of the silica or manganese getting below the level of the rim of the basin would have a good chance of being deposited in the basin.

The time of Franciscan deposition was a period of extensive volcanic activity. The presence of pillow lavas in the Franciscan group suggests that some of the volcanic rocks were poured out on the sea floor. The presence of glaucophane and related schists and the igneous rocks that have been altered to greenstone and serpentine, indicate that silica and other materials including perhaps manganese, were introduced into the rocks, and therefore inferentially some of the solutions may have escaped from the rocks into the ocean if they lay beneath sea, or on land if they did not. If they came out on land some of the silica and other materials would in part be transported back into the sea, and deposits of chert and manganese carbonate might arise. The silica almost certainly would pass through a gel stage before it consolidated. While in that stage, manganese may have been absorbed by the colloidal silica. Subsequently, as the water was removed from the silica and from the absorbed manganese, the consistency of the material would thicken and eventually a stage might be reached in which the most stable form for the manganese and silica would be a hydrous manganese silicate such as bementite. The bementite would form if the concentration of manganese were so low or equilibrium relations were such that rhodochrosite would not come down. In this way transitional zones at the edges of deposits or a thick zone of disseminated ore above an ore body such as the ore in the Ladd mine might be formed. The supply of manganese might not have been sufficient to form massive carbonates. The intimate mixture of bementite and silica in some of the disseminated ore bodies also suggests very strongly that the bementite in part at least is of sedimentary origin.

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[7] Trask, P. D., Origin and environment of source beds of petroleum, p. 230, Houston, Texas, Gulf Publishing Co., 1932.

The tongue shape of the massive ore bodies is difficult to explain. Many of the massive beds end bluntly against chert. Both the manganese beds and chert must have formed essentially at the same time, but the manganese deposits seem to have had a distinct consistency, otherwise the boundary between manganiferous rock and chert would have been indistinct. As the water in which the manganese was deposited must have been fairly well saturated with silica, possibly the interstitial water and silica between the rhodochrosite crystals that were being deposited might soon congeal into a gel and support the surrounding rhodochrosite sufficiently for it to form an independent mass on the sea floor, about which the normal chert could be deposited. This framework of silica might also act as a source of some of the silica that formed the numerous quartz veins that cut the ore.

Description of Deposits

No. 1. Callahan Prospect. (By F. S. Hudson and R. R. Morse, November 10, 1918.) H. J. Callahan and F. E. Lewis of Livermore, are prospecting for manganese in the NW¼NW¼ sec. 12, T. 4 S., R. 4 E., on land belonging to Mr. Callahan. On the south wall of the canyon some 50 feet above the bed of the stream, is an angular boulder of ore of fair grade, associated with sandstone debris, near the top of a landslide. About 250 feet N. 50° E. of this boulder a tunnel is being driven from near creek level. The tunnel runs S. 15° E. for 180 feet and then S. 40° W., 75 feet to the working face. It transverses sandstone of the Franciscan group through all of its course, except for two belts of shale. The tunnel is designed to ''get under'' the ''outcrop.'' The boulder of ore is probably float from the outcrop of the upper ore body on the Mahoney property (San Joaquin 6) on the ridge about 300 yards to the southwest. No outcrops of chert are seen between the boulder and the Mahoney outcrop, sandstone and greenstone being the only visible rocks. The chances of finding ore on this property are poor.

No. 2. Crocker Prospect. (Condensed from original description in California Min. Bur. Bull. 76, p. 64, 1918.) The Crocker prospect is in sec. 35, T. 4 S., R. 4 E., in the mountainous area 5 miles south of the Ladd (San Joaquin 5) mine. The prospect is undeveloped. The owner is M. I. Crocker.

No. 3. Cummings Mine (Lone Tree, Section 13). (By W. G. Pierce, P. D. Trask, and H. P. Norbeck, November 1941.) The Cummings mine is located in sec. 13, T. 4 S., R. 4 E. It was operated by the Manganese Company of California in 1916; and in November 1917 it was leased to James J. Cummings and Frank E. Cummings of Livermore, who operated it until 1919. A total of 2,250 tons of ore averaging 46 percent manganese and 13 percent silica was mined up to 1919. The mine has recently been reopened by the Lone Tree Mining Company, but no ore has yet been shipped.

The geologic relations of the Cummings mine are shown in plate 5. The general strike of strata in which the ore is found is northwest, and the dip approximately 60° NE. The ore is encountered in three beds through a stratigraphic interval of 75 feet. These beds were mined from open cuts and from two levels which are about 75 feet apart. The total workings are approximately 1,000 feet in length.

The south ore bed was worked first from the surface in an open stope and then from an adit below. The high-grade ore persisted only for a short distance and operations were abandoned. The length of the ore body is about 50 feet and the maximum width is 5 feet. The middle ore body, like the south ore body, was first mined from the surface and then from a raise from the upper adit. The ore was taken from two pipelike raises, one situated in the angle of a sharp fold that extends nearly vertically to the surface of the ground, and the other in an arc that extends from the upper adit to the drift near the base of the nearly vertical pipe. The ore in these pipes is of intermediate grade. The manganiferous zone present in these pipes seemingly extends northward for a distance of 150 feet, as a bed of low-grade oxide is seen in the projection of the strike at the most northerly point in the workings on the upper level. Several small faults render difficult the interpretation of the stratigraphic relation. A possible continuation of the ore is in the lower level where about 10 feet of carbonate and bementite ore is 15 feet below the north ore bed. This bed was explored along the strike for about 25 feet and found to pinch out.

The north ore bed contained the best ore, but it is now largely mined out. It extends about 85 feet along the strike and 150 feet in depth. It is seen to taper out near the limits of the present workings. The maximum width is 5 feet and the average width about 4 feet. Between the two levels it is offset short distances by several faults.

The ore still remaining in the Cummings mine is estimated to be equally divided between primary carbonate and bementite ore and disseminated oxide ore, all of which are in the middle ore body. The average grade of the ore remaining in this bed is estimated to be 20 to 25 percent. The middle bed, if mined upward from the lower adit, may pass into high-grade oxide, but difficulty will be encountered in following it because of faulting.

No. 4. Fabian Mine. (By Parker D. Trask, December 1, 1942.) The Fabian mine is in sec. 2, T. 4 S., R. 4 E., about 2,000 feet northwest of the Ladd mine (San Joaquin 5) in the continuation of the strike of the Ladd mine. The mine is located on the Connelly Ranch, and is under lease to Mack C. Lake of San Francisco. The production of the mine is not known, but is probably of the order of 2,000 tons.

The ore consists of massive oxide ranging to 8 feet in thickness in the upper levels, and of carbonate and bementite in the lower levels. The ore body is probably about 200 feet long. The mine was operated contemporaneously with the Ladd mine. It contains two levels between which ore has been stoped out. The mine is now flooded, and the reserves are not known, but the mine is believed to be largely depleted of oxide ore. The engineers at the U. S. Bureau of Mines sank diamond drill holes into the ore body some 75 feet beneath the lowest levels. These drill holes encountered carbonate and bementite ore containing 20 to 30 percent manganese. Reserves are estimated to be 5,000 tons of primary carbonate and bementite ore. For further details see the description of Ladd mine (San Joaquin 5).

No. 5. Ladd Mine (Corral Hollow Deposit). (By S. G. Lasky, W. G. Pierce, C. R. Warren, and P. D. Trask, 1940, 1941.) The Ladd mine is at the northwest end of the Ladd-Buckeye area in secs. 2 and 11, T. 4 S., R. 4 E., 13 miles by road south of Tracy (fig. 5). The mine was first opened by A. S. Ladd in 1867. In 1874 it was sold to Justinian Caire, who operated it at intervals until about 1895. The mine was purchased in 1915 by the Providence Exploration Company, of which M. C. Seagrave was director and general manager. This company was reorganized under the name of Western Rock Properties Company in February 1918. The mine has not been operated since 1919. It is now under lease to Mack C. Lake of San Francisco. The production from the mine is reported as being between 30,000 and 50,000 tons, some 10,000 tons of which was produced between 1915 and 1919.

Geologists of the U. S. Geological Survey mapped the geology of the Ladd mine and surrounding area in detail between July 1940 and December 1941. During this interval, the engineers of the U. S. Bureau of Mines, under the direction of M. E. Volin, opened up the mine and carried on exploration by means of crosscuts and diamond drill holes.

The areal geology in the vicinity of the mine is shown in plate 6. Maps of underground workings are given in plates 7 and 8. Geologic sections are given in plate 7; and a vertical projection in plate 9.

The Ladd mine contains two ore bodies which are called the east and west ore bodies. Almost all the ore produced by the mine has come from the east ore bed. The east ore bed has been explored for 800 feet in length, and at least 350 feet in depth, an unknown amount having been removed by erosion. The maximum thickness of the ore body is 35 feet, including both high-grade and disseminated ore. The west ore bed which lies 125 feet stratigraphically above the east ore bed, has dimensions of 170 by 100 feet, and a maximum thickness of 4 feet. It has been mined from two levels (pl. 8), and seemingly has yielded 500 tons of ore.

The east ore bed has been mined on four levels and several sublevels and in open cuts (pls. 7 and 8). The three highest levels, called the upper, middle, and lower levels, respectively, were mined from adits. Another level called the winze level, is reached by a winze from the lower level. It is now filled with water. The total length of these workings is about 3,500 feet. Only the basal part of the total thickness of the ore body has been mined, as the overlying part consists of low-grade disseminated ore. The thickness of the ore that has been mined ranges from 18 inches to 16 feet. The walls on the two sides of the stopes have stood up well, as few stopes have caved. In fact, the ends of the stulls have been crushed very little.

The ore bed strikes northwest and in general dips 50° SW. It, however, has been folded into several moderately compressed folds whose axes pitch about 30° NW. (pl. 8).

As illustrated by plates 6, 7, and 8, the ore is found in a chert body which is 600 feet in thickness and lies in sandstone and shale. The east or main ore bed is 50 feet above the base of the chert. This ore bed is underlain by a hard massive zone of chert 5 feet thick, which has been a good guide for the footwall of the ore in mining operations. The ore is overlain by 5 to 10 feet of soft white chert and this in turn is overlain by a variable amount of thin-bedded red chert, which on the average is 125 feet thick. This red chert is followed by a more or less thin-bedded white chert, having a maximum thickness of 50 feet. The west ore body is in this chert. Above the west ore body is a thick section of thin-bedded red chert which in places has been altered to phyllite (pl. 6). All the different types of chert except the massive chert at the base of the east ore body, vary considerably in thickness and lithologic nature within short distances, as is illustrated by the different sections shown in plate 7.

The ore in the east ore body above the lower level has been oxidized. Below the lower level it consists of disseminated and massive gray rhodochrosite and of bementite. The bementite in places alternates with the rhodochrosite in bands 0.05 to 0.25 inch in thickness. In some places the bementite is disseminated in chert, and in other places small spherules of rhodochrosite are embedded in chert. The data from the drill holes of the U. S. Bureau of Mines indicate that at least 90 percent of the ore in the mine lay above the base of the zone of oxidation, which is very close to the present water level in the mine.

In the past only high-grade oxide was mined. Its contact with an underlying thin bed of brown or buff chert is sharp and well-defined. The boundary between the high-grade ore and the overlying disseminated ore is transitional. In places zones of high-grade ore are found in the disseminated ore 10 or 15 feet above the base of the ore zone. The grade of the ore in general, however, becomes progressively less upward. The top of the ore is poorly defined; in places it seemingly grades into manganiferous chert containing a small amount of manganese.

The manganese ore is confined almost entirely to single stratigraphic zones and does not appear to have migrated much, as a result of hydrothermal alteration. However, it is cut by a network of quartz and rhodochrosite veins. Below the zone of oxidation the ore body is cut by a few thin calcite veins.

The west ore bed contains only manganese oxide minerals. In the 1,130-foot level it has some massive ore, but in the 1,034-foot level it consists largely of disseminated ore (pl. 8). A zone of white chert stained with black oxides is all that represents the ore bed in the middle tunnel, 70 feet below the 1,034-foot level.

The rocks in the Ladd mine are broken by three main faults. In most places the ore bed can be traced without interruption except for offsets of 1 foot or 2 feet; but in the central part of its linear extent it is displaced by two faults called the Ladd and Steep faults. The Ladd fault in the lower level is about 300 feet south of the portal and the Steep fault is about 100 feet south of the Ladd fault. Both faults strike in a westerly direction. The trace of the Ladd fault, however, changes abruptly to the northwest at its intersection with the lower level and at this place several small faults branch from it toward the southeast. The dip of the Ladd fault is 50° to 60° N., and that of the Steep fault is 75° to 80° N. The rocks between the two faults have been displaced to the west. The offset along the Steep fault on the lower level is about 200 feet, but on the middle level 75 feet above, as indicated by drill hole No. 3, it is about 75 feet. The movement on the block between the faults, therefore, seems to have been pivotal.

In the upper tunnel the beds are offset approximately 50 feet by a low angle fault called the Flat fault. This fault strikes north and dips in general 20° E. A similar fault which dips 35° E. in the 1,034-foot tunnel on the west ore bed is correlated with the Flat fault (pl. 8). This fault is one of the latest faults in the mine as it offsets the other faults.

In addition, a fault that strikes northwest and dips 55° N. is encountered in the middle level, a few feet north of its junction with the adit. The displacement is less than 20 feet, the north side having moved west. The fault feathers out and disappears in the working above.

Another fault south of the Flat fault on the upper (1,058-foot) level, called the Pivotal fault, displaces the ore bed in a hingelike fashion. This fault strikes northwest and dips 55° N. In the floor of the upper level the displacement is practically nothing, but toward the south the displacement increases to 20 feet within a distance of 50 feet.

The Ladd mine has been fairly completely mined of high-grade oxide ore. As indicated by the plan of the workings in plate 7, the southeast end of the ore body trends northwest at an angle of 30° to 35°. The U. S. Bureau of Mines drill hole No. 1 which was designed to intersect the ore bed 75 to 100 feet below the lowest workings encountered no mineable ore. The richest assay was 7 percent manganese in a chert bed which lies in the projection of the ore bed above. The grade of ore in the winze level is less than in the lower level 25 feet above, which suggests that the ore body does not extend much deeper. Drill holes No. 4 and No. 5 at the north end of the workings likewise disclosed no mineable ore. Drill hole No. 2 which is located 200 feet north of Drill hole No. 1 encountered the horizon of the east ore bed about 30 feet below the level of the lower tunnel, but found no ore. A crosscut and raise made by the U. S. Bureau of Mines on the lower level about 50 feet south of Drill hole No. 1, penetrated 5 feet of low-grade ore. Consequently the lower limit of ore probably is not more than 50 feet below the lowest workings.

Previous operations did not disclose the presence of ore in the block between the Ladd and Steep faults. Drill hole No. 3 encountered 10 feet of ore containing about 15 percent manganese at the level of the middle tunnel. The ore, therefore, seems to diminish in grade and thickness in this fault block.

The ore bed attains its maximum thickness of 35 feet of high-grade and disseminated ore in the middle tunnel about at the intersection of the adit with the ore bed (pl. 8). The maximum thickness in the upper level is 25 feet. The width of the outcrop of the ore body on the surface of the ground is 50 feet in many places. As the dip of the surface beds in the south part of the mine is less than 45°, the thickness of the ore bed on the outcrop is 30 or 35 feet. As surface concentration of manganese may cause ore to be found over a greater area than at some distance below the surface, the ore zone actually may not thicken upward from the upper level, as suggested by the width of the surface outcrop. The width of the ore as shown in the sections on plate 7, in places is less than the width indicated on the section, because the sections are not normal to the strike.

The reserves of the Ladd mine are estimated to be 190,000 short tons of oxide ore, averaging approximately 20 percent manganese; and 10,000 tons of carbonate and bementite ore averaging 20 percent manganese. These figures are based on more than 250 assays made by the U. S. Bureau of Mines. By means of careful sorting perhaps as much as 7,000 tons of oxide ore averaging 45 percent manganese, or 25,000 tons averaging 35 percent manganese could be obtained. About 7,000 tons of carbonate ore averaging 35 percent manganese might be procured.

The control for these estimates, however, is not sufficient to regard them as measurable ore. They should instead be considered as indicated ore. Ore in sight perhaps is 10 to 25 percent less. The estimates are based on 1 ton of ore for each 10 cubic feet of rock in place. As the oxide ore is somewhat porous, the weight of ore per cubic foot may be less than the figure assumed. Reserves, hence, may be smaller than given.

No. 6. The Mahoney (Doak) Mine. (By Max D. Crittenden, Jr., July 1944.) The Mahoney, or Doak, mine is in sec. 11, T. 4 S., R. 4 E., across the canyon southeast of the Ladd mine. It was opened in 1918 by R. G. Mahoney and J. W. Bender, but no production is recorded. The original workings consisted of several open cuts on the crest of the ridge, and adits on both sides about 70 feet below. Operation during World War II was begun in 1943 (?) by A. W. V. Johnson, who reopened the old adit on the north side of the ridge and drove a new one 50 feet below it. The lower adit exposed two beds of ore. A third adit was driven still lower to mine the lowest part of the No. 1 bed. Production to July 1944 was 1,656 tons, averaging 41.9 percent manganese.

The ore bodies are near the base of a thick lens of chert of the Franciscan group, approximately at the same stratigraphic horizon as in the Ladd mine (pl. 6). They are 25 feet apart in the original open cuts. The strike is N. 35° W., and the dip is steep. The original upper adit, 1,090 feet (pl. 10), follows what is for convenience called the No. 2 ore bed for a distance of 140 feet. On this level, the dip is 65° to 75° SW. The northwest end of the ore bed is exposed in the short cross cut 40 feet from the portal, and here it is less than 2 feet in width. The ore is manganese oxide in a siliceous matrix. It appears to contain less than 10 percent manganese. The width and grade increase gradually toward the southeast, reaching a width of 5 feet and having as much as 45 percent manganese in pockets near the face. This part of the body is directly above the stope at the southeast end of the lower adit.

Manganese oxide ore averaging 41.8 percent manganese was found in the lower adit 65 feet from the portal. This body, which is herein termed the No. 1 ore bed, proved to be over 60 feet long, 8 to 10 feet thick, and to extend 30 feet up and down the dip. The deepest part is northwest of the main crosscut and was mined from a short adit at a still lower level. The ore body was followed 100 feet southeast from the main crosscut, but is lower in grade and considerably thinner in this direction. Only a small amount of ore was obtained from the small stopes at the southeast end of this drift. The dip of the bed varies from 60° NE. at the southeast end to 20° NE. at the northeast end. The high-grade ore appears to have lain in a "pocket" formed by the intersection of the ore bed and a steep fault which passes into a small sharp fold along the strike to the southeast.

The No. 2 ore bed is exposed in the main crosscut of the lower or main adit (1,038 feet) 155 feet from the portal. It consists of a zone of oxidized and partly leached manganiferous chert 1.5 to 2 feet thick, striking N. 50° W., and dipping 55° NE. The drift that trends southeast follows a steep fault which appears to displace the ore bed for a distance of 80 feet. The main No. 2 ore body was encountered in the hanging wall of the fault 30 feet to the south, and 10 feet above the level of the adit. This body has been stoped for 60 feet along the strike, from a zone 5 to 10 feet wide, and to within 6 feet of the upper adit. The dip on the upper level is 75° SW., but the dip changes to vertical halfway down the stope, and to 75° NE. in the floor of the stope. There is no evidence to indicate which is the overturned dip. At least 500 tons of oxide ore averaging 35 to 37 percent manganese have been produced from this body.

The primary ore from which the manganese oxides are derived is not exposed in the Mahoney mine. However, the thin lens that represents the No. 2 ore body in the main crosscut, and the material in the face and floor of the stopes at the southeast end of the No. 1 ore body, show transitional stages in the process of oxidation. This material consists of vuggy cellular chert veined and partly replaced by manganese oxides. The porous texture is due to leaching of part of the silica and alumina by ground water, leaving a powdery mixture of iron or manganese oxides in the cavities. The primary ore must have been largely manganiferous chert containing 5 to 25 percent manganese. The probability is small for finding significant amounts of oxide ore in the Mahoney mine when the present bodies are mined out. The two principal ore bodies are shown to be lenticular, and to lens out practically within the workings themselves. The primary ore is too low in grade to be of value.

No. 7. Scott Prospect. (By Frank S. Simons, October 6, 1942.) The Scott prospect is in the NW¼ sec. 34, T. 4 S., R. 4 E., 4 miles by road from the Arroyo Mocho road and 24.5 miles from Livermore. It is on land owned by Charles Scott of Livermore, and is under lease to A. C. Aitken and F. L. Wolfe, of San Francisco. The prospect is on Taylor Ridge, at an elevation of about 3,000 feet. Manganese is found at five places in an area about a quarter of a mile square, the ore occurring in thin chert beds interbedded with sandstone. The deposits will be described by the numbers that the owners have given them.

Deposit I is a bed of siliceous manganese oxide ore, enclosed in thin-bedded shaly chert. It can be traced along the surface for 40 feet, where it has been exposed by bulldozing and by a few shallow cuts. The strike is N. 10° W., the dip about 20° E. At the south end the bed appears to be 1 foot thick, and the ore contains about 30 percent manganese. At the north end the thickness is uncertain as the attitude of the bed cannot be determined, but it is probably about 5 feet. The ore is low grade, containing perhaps 10 percent manganese. Approximately 5 tons of sorted ore containing about 30 percent manganese is on the stock pile. Most of the ore consists of a network of thin quartz veins enclosing pockets of manganese oxide mixed with rusty colored leached chert. This deposit is not promising, as most of the ore is low grade, and the amount of ore containing 30 percent manganese is small.

Deposit II is an irregular bed of manganese oxide ore enclosed in faulted chert. The chert strikes north and dips 55° W., massive white chert forming the footwall of the ore body, and shaly chert forming the hanging wall. The ore bed is 3 feet thick near the north end, and lenses out rapidly to the north. The bed can be traced for 30 feet along the strike, and is said to have continued for 10 feet farther, prior to being covered with debris. The ore is siliceous oxide, containing about 35 percent manganese. It is cut by numerous thin veins of a brown carbonate which may be siderite. Five tons has been mined, and another 10 tons is in sight. No more ore can be inferred to be present because of the many faults. This is the most promising deposit of the Scott prospect, but it gives little hope for the development of any considerable tonnage.

Deposit III was completely removed by the bulldozer in constructing the road. It apparently consisted of a thin lens of manganiferous chert, and, as the road cut is not large, the deposit was not impressive at any time.

Deposit IV consists of thin films of manganese oxide on white chert. The chert strikes N. 55° W., and dips 40° SW. One small pocket of ore is said to have been found, but no ore is in sight at present. The deposit is 100 feet south of deposit II.

Deposit V is 100 feet west of deposit II. A bulldozer cut exposed 4 feet of very siliceous manganese oxide ore that can be traced for 30 feet along the strike. The ore is enclosed in shaly chert. The chert is faulted against sandstone at the west end of the cut, and the ore appears to lens into massive chert at the east end.

About 10 tons of ore containing 20 percent manganese is present, but most of the ore is a slightly manganiferous chert containing thin films of oxide. The chert has been sheared into small blocks and into egg-shaped fragments, each uniformly coated with manganese oxide. Some of these fragments resemble concretions.

From the foregoing descriptions, it can be seen that the Scott prospect is not considered as hopeful. None of the deposits gives much promise of a large tonnage, and only one (deposit II) has any ore containing 35 percent manganese. The deposits do not seem to be related to one another, each being a small and entirely separate ore body. The predominance of sandstone in the area suggests that no large tonnage of ore will be found.

SAN LUIS OBISPO COUNTY

No. 1. Barneberg Mine. (By F. S. Hudson and G. H. Alvey, July 31, 1918.) The Barneberg mine is on the property of Anton Staneuche, of San Luis Obispo. It is 6 miles southwest of San Luis Obispo, in the NE¼NE¼ sec. 7, T. 31 S., R. 12 E. It is operated under lease by J. W. Barneberg of San Luis Obispo. The workings are at an altitude of 800 feet on the road from San Luis to the Staneuche mine. The road is good except for the last 2 miles. This deposit is within the same body of chert as the Staneuche mine (San Luis Obispo 24), half a mile to the northwest. The strike is about N. 30° W., and the dip 75° to 80° E. The ore occurs as a thin bed of laminated black oxide, lying between a massive bed of yellow chert on the west, and thin-bedded chert on the east.

About 35 tons of ore has been removed from an open cut which runs 60 feet along the strike, and has reached a depth of about 15 feet below the outcrop. This ore is said to carry 45 percent manganese, 19 percent silica, and is resorted to lower the silica. It is likely that the ore pile probably contained less than 15 percent silica as it stood. About 100 feet northeast of the open cut, and 60 feet lower in altitude, a tunnel is being driven S. 55° W. to cut the ore in depth. On the day of visit the face was 78 feet in, and chert had not yet been encountered. The ore horizon should be reached within 40 feet more.

A second tunnel has been started 150 yards S. 20° E., and 170 feet below, the open cut. The mouth of this tunnel is immediately adjacent to the road. The tunnel is in thin-bedded chert and shale for its entire length of 78 feet. The chert beds strike N. 25°-30° W., and dip 78° E. so the tunnel crosses them toward the footwall massive chert, at a very low angle, about 10°. If the strike persists, the massive chert contact should be reached within 25 feet, but there is no assurance that any ore will be found at this point, as none has been found at the corresponding point on the surface. A few yards southwest of the mouth of the tunnel trenching has been done along a cross fault, which offsets the chert beds 50 feet. Along the fault plane manganese occurs as thin coatings and seams, suggesting that at some place the fault cuts ore.

This deposit was visited by F. S. Simons on March 30, 1942, who reports that no work has been done recently, and the two main tunnels are caved. The northeast tunnel is still open, but no ore is exposed in it except a thin seam of manganese oxide near the portal. Work on this tunnel ceased before the ore horizon was reached. No information could be found on the lower tunnel near the road, so the implication is strong that it failed to reveal ore.

Little ore was in sight in 1942, the main ore bed being only 18 inches thick at the thickest place. Inasmuch as the ore bed was very thin at a depth of 15 feet, the chance of finding a thick bed at lower levels is not promising. The maximum depth of the ore bed is not known, as one exploration tunnel failed to reach the ore horizon and the other is now caved.

No. 2. Black Mountain Prospect. (By F. S. Hudson and G. H. Alvey, August 5, 1918.) The Black Mountain prospect is on government land in sec. 34, T. 26 S., R. 9 E., in San Luis Obispo County. It is at an altitude of 2,000 feet, 6 miles in an air line N. 48° E. of Cambria, and is reached from that place by 5 miles of road and 5 miles of trail, the total distance to San Luis Obispo on the Southern Pacific Railroad being 45 miles. The claimants are Fred Williams and Joe Sousa, of Cambria, and Walter Carpenter of San Luis Obispo. A small amount of work has been done on the west side of a prominent outcrop of yellow-brown, massive chert. The outcrop here forms a cliff and on its face are heavy stains of black oxide. Two trenches into the face have uncovered a few streaks of dark-brown, very siliceous, resinous ore enclosed in the massive chert. At the foot of the cliff the soil contains numerous fragments of chert. If manganese ore occurs at this locality it should be searched for along the west wall of the massive chert, beneath the detritus.

No. 3. Bluebird Mine. (By F. S. Hudson and G. H. Alvey, August 12, 1918.) The Bluebird mine lies about 42 miles by road S. 70° W. from Atascadero at an altitude of 1,350 feet. It is situated on Asuncion Rancho, the land of which has not been sectionized. If the sections were projected, the mine would lie in the NW$\frac{1}{4}$NE$\frac{1}{4}$ sec. 30, T. 28 S., R. 12 E., San Luis Obispo County. The mine is on the land of the Lewis Foundation Corporation and is operated by the Department of Mines and Metallurgy of that company. The manager is J. N. Bissell of Atascadero.

Open cut work has exposed a ledge of manganese-bearing material for 125 feet along a strike of N. 70° W. This ledge varies from 3 to 6 feet in width. Its depth is not known. The ore body is a massive bed of manganiferous chert. A small amount of thin-bedded red chert and shale was seen along the south wall of the ore at one place. Aside from this thin-bedded chert, both walls of the ore body are altered basalt or diabase (greenstone). At its western end the ore body appears to be cut off by the greenstone, and 35 feet beyond this point a small block of ore completely surrounded by greenstone was found. The greater part of the ore body is a highly siliceous finely crystalline material stained black by manganese oxide. Some specimens show veins of a pink manganese silicate and veins of light-brown resinous-lustered material. The ore in sight does not average better than 15 percent manganese or less than 50 percent silica. Small amounts of better grade ore have been found on the periphery of joint bounded blocks. Production is 100 tons.

No. 4. Egenes Prospect. (By Spangler Ricker, 1942.) The Egenes prospect is in T. 30 S., R. 14 E., 12 miles south of Santa Margarita, 1 mile off the road from Santa Margarita to Pozo. The ore bodies consist of small lenses of manganese oxide in chert. They crop out for a distance of 10 feet along the strike and the mineralized zone has a maximum width of 5 feet. Representative samples assayed from 31 to 52 percent manganese, 0.61 to 1.08 percent iron, and 15 to 30 percent silica.

No. 5. Evans Prospects. (Modified slightly from the original description in California Min. Bur. Bull. 76, p. 70, 1918.) W. Evans and J. Evans of San Simeon, own two prospects located on steep hills above San Carpojaro Creek, one in sec. 3, T. 25 S., R. 6 E., and the other, 2 miles distant. Though only a short distance from the ocean, the ore would have to be taken down steep slopes to reach the road, which follows the bed of San Carpojaro Creek, and then would have to be hauled 5 and 7 miles, respectively, to the mouth of the creek. The J. Evans prospect shows manganese oxides in a jasper lens 10 feet in width, which can be traced for a considerable distance on the surface. The strike of the lens is N. 60° E., and the outcrop is heavily stained with manganese for a width of 60 feet. Several shallow holes have been sunk along the outcrop, exposing manganese ore apparently carrying much silica. The W. Evans prospect contains a pocket of manganese oxides 5 feet wide. Recent assays indicate 48 and 37 percent manganese, respectively, and 8 percent silica. A previous assay indicated much less manganese and a high silica content. As noted elsewhere, the manganese oxides are in bunches, which grade into material stained black, which resembles ore but is nearly all silica.

No. 6. Hearst Ranch-Marmolejo Creek Deposit. (By F. S. Simons, April 1942.) The Marmolejo Creek deposit is on the William Randolph Hearst Ranch in the south center of sec. 1, T. 26 S., R. 7 E. It is on Marmolejo Creek 0.5 mile above the confluences of Burnett Creek, and is 0.2 mile from a good road to San Simeon, 10 miles distant. The property is 51 miles from the railroad at San Luis Obispo.

On the south side of Marmolejo canyon is a steep wall of sandstone 100 feet across the outcrop, flanked by serpentine and greenstone on the east and greenstone on the west. The ore occurs as large boulders in the creek bottom. The only ore that may be in place is at the contact of the sandstone and serpentine, but the relations are obscure because of landsliding from the canyon wall. The boulders are apparently near their source, as no float was found upstream from the sandstone.

The boulders are as much as 15 feet in diameter, and consist of manganese oxide and calcite, with numerous small rhodochrosite veins cutting the massive ore. A small part of the ore is a breccia cemented by oxide and reddish clay. The origin of the ore is doubtful, one difficulty being that the country rock is largely, if not entirely, either part of a landslide or is covered by landslide material. The ore might be a replacement of limestone, a bedded manganiferous carbonate deposit, or a carbonate vein. No development work has been done.

No. 7. Hearst Ranch-Red Rock Deposit. (By Frank S. Simons, April 1942.) The Red Rock deposit is on the William Randolph Hearst ranch at San Simeon. The deposit is in the NE¼SE¼ sec. 13, T. 26 S., R. 7 E. A road formerly ran to within a few hundred yards of the deposit, but the last mile of this road is now impassable. No work is being done on the deposit at present. The property is 41 miles from the railroad at San Luis Obispo.

The country rock is largely serpentine. A small fault sliver of sandstone is associated with the ore. No chert is exposed within 100 feet of the ore, and none was seen in the workings, although the core of one of the manganese oxide nodules contained some quartz which may represent recrystallized chert. Development consists of two open cuts, 100 feet apart, exposing nodules of manganese oxide ore in faulted serpentine. The nodules consist of a core of massive hard brownish-black oxide with a rim of a peculiar steel-gray or bluish-black, divergently bladed metallic mineral, with a hardness of about 6 and a dark-brown streak. This mineral is probably psilomelane. The nodules appear to be superficial concentrations of manganese oxide, possibly from the weathering of the sandstone, which contains a small amount of disseminated manganese oxide, or from the weathering of a formerly present manganiferous chert.

The nodules may be as much as 5 feet in diameter, but are usually only 2 or 3 feet, and have an irregular shape. They occur only near the surface, at least in the lower cut, where a short tunnel and crosscut failed to find ore below a depth of ten feet. The nodules are probably present in a more or less continuous line between the two cuts, although no ore is exposed at present anywhere but in the cuts. The deposit presumably does not reach any considerable depth.

A few tons of ore, averaging probably better than 40 percent manganese, are piled on the dump. Prospects of finding any large amount of ore are not good. The past production of this mine is 70 tons.

No. 8. Hill Prospect. (From files of U. S. Geological Survey.) The Hill prospect is in sec. 16, T. 28 S., R. 9 E. No other information is available.

No. 9. Hobson Claims. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 70, 1918.) W. K. Hobson of Cayucos has several claims originally located for copper and chrome on which is a bed of chert 10 to 15 feet wide. The chert is coated with manganese oxides. The claims are in T. 28 S., R. 11 E., 8 miles east of Cayucos on the west side of the Santa Lucia Range between Morro and Toro Creeks. This deposit is a continuation of the Phelan prospect (San Luis Obispo 20).

No. 10. Isom Prospect. (By F. S. Hudson and G. H. Alvey, August 1918.) H. E. Haskins and Cleon Kyte of Arroyo Grande have prospected for manganese on the land of Dave Isom of Edna, at a point 3.5 miles N. 83° E. from Edna Station on the Southern Pacific Railroad. The deposit is in sec. 23, T. 31 S., R. 13 E. An 8-foot layer of massive chert impregnated with black manganese oxide occurs here. Thin-bedded green chert lies above and below the massive bed. The strike is N. 27° W., and the dip 40° NE. The highest-grade ore contains less than 25 percent manganese and has 50 percent or more of silica. The prospects for obtaining good ore at this locality are small, as the prospecting work has exposed

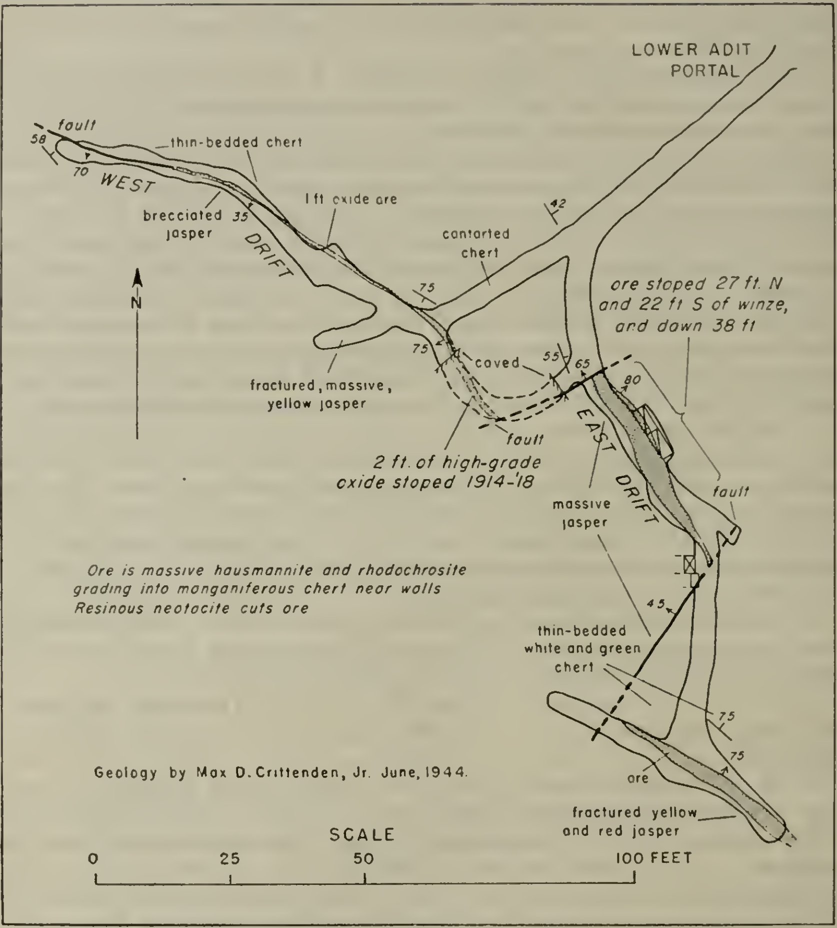
LOWER ADIT PORTAL
fault
58
70
WEST DRIFT
thin-bedded chert
brecciated jasper
35
1 ft oxide ore
contorted chert
42
75
N
fractured, massive, yellow jasper
75
caved
55
65
80
ore stoped 27 ft. N and 22 ft S of winze, and down 38 ft
fault
2 ft. of high-grade oxide stoped 1914-'18
EAST DRIFT
massive jasper
fault
Ore is massive hausmannite and rhodochrosite grading into manganiferous chert near walls Resinous neotocite cuts ore
45
thin-bedded white and green chert
75
75
ore
Geology by Max D. Crittenden, Jr. June, 1944.
fractured yellow and red jasper
SCALE
0
25
50
100 FEET

FIGURE 6. Plan of lower level of the Johe Ranch mine, San Luis Obispo County, California.

the entire width of the massive chert layer without encountering any high-grade material.

No. 11. Johe Ranch Mine. (By Frank S. Simons, April 1, 1942, and Max D. Crittenden, Jr., June 17, 1944.) The Johe Ranch mine is in the SE$\frac{1}{4}$SE$\frac{1}{4}$ sec. 35, T. 30 S., R. 11 E. It is 10 miles west of San Luis Obispo on the ranch owned by George H. Johe, and is leased to John Byrnes, Shelby Elliot, and A. T. Adams, who during 1943 and 1944 produced 454 tons of ore containing 40 to 54 percent manganese. The mine was operated in World War I and is reported to have produced 32 cars of ore. At that time it was worked from three leveles: the lower level was driven 190 feet from the creek bottom; the middle level, 60 feet above the creek, was driven in 75 feet; and the upper level, 50 feet above the middle level, was driven an unknown distance. All the ore was taken from the upper level, as no ore was found in the lowest level, and the middle level stopped just short of the ore bed.

The principal development during 1943 and 1944 was the reopening of the lowest of the three adits in which oxide ore was found during World War I. The old workings consisted of the main adit, and the west drift, which follows a thin ore horizon for 100 feet. A short cross cut was also driven along the fault which displaces the ore zone, but it failed at that time to expose the offset segment of the ore bed which was discovered during the new work when the crosscut was extended farther northeast. A new connection to the main adit was then made, and the ore was followed south for 40 feet to another fault on which the ore was displaced to the west. This third segment had been followed for about 40 feet south of the fault in June 1944. The middle fault block has been stoped to a depth of 38 feet below the adit level, and for a length of 40 feet. The relationships are illustrated in figure 6.

As in several other deposits of the San Luis Obispo area, the ore at the Johe Ranch mine occurs between massive jasper and contorted thin-bedded green and white chert of the Franciscan group. It is uncertain whether the jasper is stratigraphically above or below the ore horizon, since the beds dip southeast in the west drift and northwest in the east branch. All of the ore exposed in the west branch of the adit is primary ore consisting chiefly of hausmannite and manganiferous chert. It was found in lenticular masses 1 foot to 4 feet thick, which probably average 45 percent manganese. A shipping grade of over 50 percent was maintained in 1944 by sorting some of the lower-grade material near the walls. In the east face of the drift, the central portion of the ore body is highest in grade and commonly is largely hausmannite. The ore becomes more siliceous toward the walls, grading into manganiferous chert and finally into jasper or thin-bedded chert. The ore is veined by quartz and by clear resinous neotocite that cuts both the hausmannite and the manganiferous chert.

The principal reserves of this deposit are in the east drift, above the east drift in the middle fault block, and both above and below the drift level in the east block. The average grade is at least 45 percent manganese.

No. 12. Kester Prospect. (By E. F. Davis and F. S. Hudson, January 5, 1918.) The Kester prospect is in T. 29 S., R. 10 E., 1 mile north of Morro on a small knob just east of the Morro-Cayucos road, at a point where this road crosses Morro Creek. The prospect is situated on the land owned by Pedro Quintano of San Luis Obispo and the lease is held by Ralph Kester, Joaquin Quintano, and D. R. Hazzard. The north slope of the knob is covered by outcrops of radiolarian chert of various types. At several places the outcrops of bodies of massive chert are stained with manganese oxide. Only a little exploration work has been done and farther work would not be justified.

No. 13. Lanscioni Prospect. (By F. S. Hudson and G. H. Alvey, August 8, 1918.) The Lanscioni prospect is 5.5 miles northwest of San Luis Obispo on the land of Mrs. Luisa Lancioni of San Luis Obispo, in sec. 13, T. 30 S., R. 11 E. The ore is found within a chert lens which crops out for 15 feet. The strike is N. 55° W., and the dip is steep to the north. On the north side of this chert body is 2 feet or more of black, resinous, siliceous manganese ore, carrying finely porous, white spherules of silica. The best ore in sight probably runs less than 40 percent manganese and at least 25 percent silica. No work has been done at this locality, although it seems worthy of prospecting.

No. 14. Marquart Prospect. (By F. S. Hudson and G. H. Alvey, August 4, 1918.) The Marquart prospect is at an altitude of 650 feet, 550 yards N. 55° W. of J. R. Marquart's house, 7 miles from Cambria on Santa Rosa Creek in San Luis Obispo County, in sec. 23, T. 27 S., R. 9 E. The manganese is found as coatings of black oxide on seams and joints in a block of massive chert, which is apparently included within altered basalt or diabase (greenstone). The best material carries less than 10 percent manganese and over 50 percent silica. Nothing was seen to warrant further work.

No. 15. Mayfield Prospect. (By F. S. Hudson and G. H. Alvey, August 5, 1918.) The Mayfield prospect is in sec. 1, T. 27 S., R. 9 E., on the property of Solon Mayfield of Cambria. It is at an elevation of about 2,750 feet just west of the summit of the Santa Lucia Range. It is 19 miles by road and trail N. 80° E. from Cambria. The total distance to San Luis Obispo on the Southern Pacific Railroad is 45 miles.

The predominant rock of this locality is an altered basalt, or greenstone. Small blocks of jasper are included in the greenstone. A small amount of oxidized manganese ore is associated with one of these jasper inclusions. This ore varies from very siliceous black flinty material to ore of apparently good grade. A sample taken across a 4-foot face assayed 49.3 percent manganese and 18.7 percent insoluble. Since this ore occurs as an inclusion in greenstone, little additional ore will probably be found.

No. 16. Mello Prospects. (By Frank S. Simons, April 1942.) The Mello prospects are in the SE¼ sec. 8, T. 31 S., R. 13 E. They are within half a mile of the road from San Luis Obispo to Edna, which runs east of Islay Hill. The owner is D. Mello. Three outcrops of ore have been worked, but with no favorable results. At the northwest deposit, very low-grade ore occurs at the base of a massive chert bed which strikes N. 80° W., and dips 45° NE. No well-defined ore bed was seen, and the ore is mainly thin-bedded chert with irregular thin films of manganese oxide. The chert carries less than 5 percent manganese. The south deposit is a few hundred feet along the strike of the chert from the northwest deposit. The ore occurs as pockets in brown leached chert, interbedded with a replacement (?) breccia of chert and quartz. The country rock is manganiferous, with black films along bedding surfaces and joints. The ore is low grade except for a few small pockets of high-grade blue-black oxide. About a ton of ore, averaging 15 percent manganese, has been taken from two small cuts. No ore is exposed at present. At the southeast deposit, 200 yards east of the south deposit, on open cut exposes 3 feet of manganiferous chert, striking N. 55° E., and dipping 45° NW. The manganese content of the chert is less than 10 percent.

No. 17. Morro Bay (Follet Ranch) Prospect. (By Frank S. Simons, April 4, 1942.) The Follet Ranch or Morro Bay prospect is in the SE¼ sec. 22, T. 28 S., R. 9 E., on the Follett Ranch, owned by a Mrs. Follet of San Luis Obispo. The property has been leased by John Byrnes, Shelby Elliott, and A. T. Adams of San Luis Obispo. The prospect is 1 mile from a point on the Villa Creek road, 0.6 mile from the Cayucos-Cambria road, at an altitude of about 250 feet. The owners are planning to build a road direct to the mine from a point in Ellysly Creek on the main road. The property is 22 miles from the railroad at San Luis Obispo.

Thin-bedded brown chert forms a prominent outcrop striking northeast and dipping steeply southeast. Outcrops of manganese oxide ore can be traced for 250 feet northeast from a large open cut. This cut, called Cut 1, exposes 11 feet of siliceous manganese oxide ore striking N. 35° E., and dipping 55° SE. The hanging wall is thin-bedded brown chert; the footwall is not exposed, as the ore bed is cut off by a strike fault dipping 70° SE. Forty feet northeast of Cut 1 is another open cut, exposing 6 feet of ore. From here manganiferous outcrops are exposed in a series of shallow pits for a distance of 175 feet northeast, where the ore bed appears to end.

The footwall of the fault in Cut 1 is manganiferous chert, the manganese oxide possibly being leached from the hanging-wall material and redeposited. This fault can be traced into Cut 2, where neither wall is manganiferous, so the fault apparently swings away from the ore bed, exposing the footwall of the ore.

The ore in Cut 1 consists of manganiferous white chert. Films of manganese oxide on joint and bedding surfaces and a few veins of oxide up to several inches in thickness are present. About 1 foot from the hanging wall, a zone of high-grade ore, 1 foot thick, occurs. The ore bed is at least 11 feet thick, but the total thickness is not exposed. The ore is massive shiny black oxide, probably psilomelane.

This is a rather promising prospect. Although the 11-foot bed averages only about 25 percent manganese, there is enough high-grade ore which can be sorted to at least 40 percent manganese, to make mining profitable. The possibility of developing a large tonnage is good, as manganese ore crops out more or less continuously for 250 feet. Most of the outcrops are of low grade, but numerous pieces of high-grade ore are scattered along the strike of the beds. Fifteen tons of ore averaging 40 percent manganese are piled near Cut 1. This ore came largely from the high-grade bed near the hanging wall.

No. 18. Muscio Prospect. (Modified slightly from original description in California Div. Mines Rept. 31, p. 427, 1935.) The Muscio prospect owned by Dante Muscio of San Luis Obispo, is near Cayucos, in T. 28 S., R. 10 E. It has yielded a small amount of ore.

No. 19. The O'Connor Ranch (Mt. Bishop) Mine. (By Max D. Crittenden, Jr., June 19, 1944.) The O'Connor Ranch mine, also termed the Mt. Bishop mine, is in the SE¼ sec. 19, and the SW¼ sec. 20, T. 30 S., R. 12 E. It is on the southwest slope of a peak, about 8 miles by road southwest from San Luis Obispo. The mine is on the O'Connor Ranch owned by Mrs. Mary Fischer, and was leased in the spring of 1944 to

Charles Naslund of San Luis Obispo. Production in World War I is reported as 250 tons, and 188 long dry tons of ore averaging 48.8 percent manganese were shipped to the Metals Reserve Company stock pile at San Luis Obispo in 1944.

Development consists of a bulldozer cut about 15 feet deep and 160 feet long, parallel to the strike of the beds. It exposed an old caved inclined shaft, which was reopened to a depth of 46 feet below the bottom of the open cut. A drift 36 feet below the bottom of the open cut followed the ore bed 100 feet northwest from the shaft. Only 30 feet of the drift was open in June 1944, however. The production in 1944 came from a single stope 10 feet wide northwest of the shaft.

The ore bed at the O'Connor Ranch mine is near the top of a lens of chert of the Franciscan group that crops out on the hill below the open cut. The ore bed is overlain by 10 feet of chert. The ore above the 36-foot level is thinly laminated oxide averaging 45 to 50 percent manganese, when sorted by hand. The ore body consists of layers of hard oxides 0.5 inch to 2 inches thick, separated by partings 0.1 to 0.2 inch thick partly filled by powdery shaly material or ochre. In the shaft below the 36-foot level, the oxides grade into primary ore consisting of banded rhodochrosite and manganiferous chert. Both of these presumably syngenetic materials are veined by resinous brown neotocite.

No. 20. Phelan Prospect. (By F. S. Hudson and G. H. Alvey, August 3, 1918.) The Phelan prospect is in sec. 11, T. 27 S., R. 8 E., on the property of the Phelan Land and Cattle Company of Cambria, about 5.5 miles in air line due north of Cambria. It lies at 1,000 feet elevation just north of the summit of the ridge south of Pico Creek. The distance by road to San Luis Obispo on the Southern Pacific Railroad, is 40 miles. The ore is found in a mass of thin-bedded chert, which persists throughout a strike length of 75 feet. The manganese is found principally in a bed half an inch thick. It is resinous and brown and probably carries 30 percent manganese and 30 percent silica. Only a small amount of ore is in sight and the prospect of finding more is poor.

No. 21. Prefumo Canyon Prospects. (By Frank S. Simons, May 16, 1942.) The Prefumo Canyon prospects are in the southeast corner sec. 6, T. 31 S., R. 12 E., near the top of the ridge northeast of Prefumo Canyon and 350 feet above a point on the road 0.6 mile from the school house. They are on the land of the Staneuche Ranch, 5 miles from San Luis Obispo. A series of thin-bedded brown and buff chert occupies the top of the ridge northeast of Prefumo Canyon. Four open cuts and a tunnel have been excavated near the ridge top exposing chert striking N. 45° W. The chert is contorted and faulted on a small scale. In all the workings manganese oxide is present as thin films on joint, fault, and bedding surfaces. None of the ore seen contains more than 10 percent manganese. A few scattered pieces of higher-grade ore are lying on the dumps, but none shows in the workings.

A quarter of a mile northwest of the above mentioned workings, a small cut exposes 5 feet of massive manganiferous white chert striking N. 80° W., and dipping 60° NE. The hanging wall is thin-bedded buff chert; the footwall is massive silicified white chert. Near the hanging wall is a 6-inch seam of manganese oxide ore, containing about 40 percent manganese, but the average of the 5 feet is about 10 percent manganese. Nothing was seen at any of these prospects that would justify further work.

No. 22. Ricioli Prospect. (By F. S. Hudson and G. H. Alvey, August 3, 1918.) The Ricioli prospect is in sec. 10, T. 28 S., R. 9 E., on the land of V. Ricioli, just east of the road, about midway between Cayucos and Cambria. The distance by road to San Luis Obispo is 28 miles. This prospect was examined by E. F. Davis and F. S. Hudson, early in 1918. At that time a bed of black resinous ore was exposed, a sample of which carried 38 percent manganese and 22 percent silica. Two tunnels show that the manganese content decreases rapidly with depth and no ore is now seen that carries over 15 or 20 percent manganese.

No. 23. Serrano Prospect. (By Frank S. Simons, April 2, 1942.) The Serrano prospect is in the NW¼NE¼ sec. 2, T. 31 S., R. 11 E., on a tributary of Clark Creek half a mile south of the Johe Ranch mine. It is on the land of Carlos Serrano of San Luis Obispo. A road leads to within half a mile of the prospect, which is near the canyon bottom in very heavy brush. The prospect is 15 miles from the railroad at San Luis Obispo.

Manganese oxide ore is exposed in a steeply dipping series of shale beds, which strike N. 45° W. The ore crops out near the creek and sporadically for 300 feet up the east canyon wall. The area is very heavily covered by brush, and exposures are poor. A hard brown siliceous sandstone lies along the south side of the shale. The ore occurs as laminae up to one-eighth inch thick, interbedded with reddish brown siliceous shale. The total thickness of the ore bed is not exposed. All the old cuts are completely caved. The maximum thickness exposed is 6 feet, but the ore-bearing shale cannot be traced continuously for more than a few feet.

No. 24. Staneuche Mine. (By F. S. Hudson, July 26, 1918.) Manganese has been mined since early in 1917 on the property of Steve Staneuche, which is 6 to 8 miles by road southwest of San Luis Obispo. All the workings are in sec. 6, T. 31 S., R. 12 E. The work is being done by the Union Chrome Company under a lease. The ore occurs within a prominent layer of chert which strikes N. 55° W. The ore bed varies from a few inches to over 4 feet in thickness and lies between a bed of massive yellow chert on the south and thin-bedded green and red chert on the north. The whole series dips to the northeast at angles ranging from 25° to 80°. Three levels at altitudes of 1,180 feet, 1,210 feet, and 1,245 feet respectively, prove the ore to have an extent of over 90 feet along the strike and over 100 feet along the dip.

In the floor of lowest level at which it has been encountered, the ore is made up of massive finely crystalline dark-brown manganese oxide, probably hausmannite. Within this ore are crystals of pink carbonate strung out in rude layers. Above this level all the ore is blue-black psilomelane through which run porous layers containing a powdery brown material. These layers give the ore a decidedly laminated structure—the lamination being parallel to the walls of the bed. The psilomelane is apparently the oxidation product of the supposed hausmannite; the powdery brown material is thought to be a residue from the oxidation of the carbonate of the primary ore.

A tunnel at 1,100 feet elevation, 80 feet below the lowest developed ore, is being driven to cut the deposit at depth. This tunnel passes for 150 feet through sandstone and shale which lie on the north side of the chert body. Beyond this, the tunnel has gone about 15 feet through thin-bedded chert, and the ore probably would be encountered within 50 feet.

As hausmannite is a primary constituent of the ore, the grade should be high.

Stancuche Mine. (By Max D. Crittenden, Jr., June 1944.) The Stancuche mine is now owned by H. H. and H. C. Dalessi, contractors, of San Luis Obispo, who shipped 537 long tons of ore averaging 55.44 percent manganese to the Metals Reserve Company stock pile at San Luis Obispo between September 2, 1943 and April 26, 1944. Workings are located on the tops of two ridges separated by a steep canyon, and for convenience will be discussed separately as the western and eastern workings.

Western Workings. The lowest workings on the west hill are in a small side canyon, just west of the house in the bottom of the main canyon. The development here during World War I apparently consisted of a single adit driven into the nose of the small ridge separating the main canyon from the tributary canyon. Mr. Dalessi made a bulldozer cut in the nose of the ridge, with a bench level about 10 feet below the floor of the adit. In addition, a new adit was driven into the ridge at a point 77 feet below the level of the open cut, but the portal was caved in June 1944.

The old adit was begun on a manganiferous bed enclosed within contorted chert of the Franciscan group. In the face of the open cut, the bed strikes N. 50° W., and dips 70° to 75° NE. The adit extends along the bed for a short distance, but the dip of the bed becomes progressively lower and finally the bed appears to lens out 25 feet from the present portal. The adit continues, following the bedding of the chert for an additional 100 feet. The manganiferous bed exposed in the mouth of the adit is 1 foot to 2 feet thick, and consists of partly oxidized manganiferous chert. The minable ore obtained from these workings was derived from the manganiferous chert by leaching and removal of silica, combined with oxidation of the manganese set free in the process. The material now visible shows veinlets and irregular areas of manganese oxides cutting and replacing cellular and powdery remnants of the original chert. Approximately 25 tons of oxide ore averaging 40 percent manganese has been removed. The material remaining is too low in grade to ship, and is not amenable to beneficiation by simple means.

The principal western workings are near the top of the main ridge west of the canyon. The present operations were done entirely by means of bulldozer stripping during which about 100 tons of ore averaging 55 percent manganese were recovered. The cut trends northwest, parallel to the length of the ridge, and exposes a face at least 50 feet high. The ore bed strikes N. 70° W., and dips 70° to 75° NE. Beneath it is massive varicolored jasper several feet thick, which forms the face of the open cut. The ore bed is overlain conformably by about 50 to 75 feet of thin-bedded chert varying in color from white to pale green or pink. Sandstone and shale dipping south at a low angle are exposed in the outer edge of the open cut. Although the rocks were not well exposed, a fault of considerable magnitude almost certainly separates the chert from the sandstone and shale.

A transverse fault zone approximately 30 feet wide which strikes N. 10° E., and dips 70° W. is exposed near the center of the open cut. It consists of a number of subparallel normal faults which displace the ore zone and its wall rocks for a total distance of 30 feet. East of the fault zone the chert overlying the ore bed has not been completely stripped. Mr. Dalessi reports that a drift now covered by slides from the face of the open cut failed to reveal a body of ore thick enough to warrant stripping.

Fragments of ore found in the cut consist of high-grade massive black manganese oxide, either pyrolusite or minerals of the psilomelane type. The primary ore was nowhere exposed. By analogy with the ore in the lower part of the western workings, and in the eastern workings, the ore probably is manganiferous chert, possibly mixed with rhodochrosite, which has been oxidized and enriched by leaching of the silica and other impurities. This process was undoubtedly facilitated by the steep dip of the beds, and the fact that they crop out near the top of a relatively narrow ridge, a combination of conditions yielding a maximum of permeability to meteoric water.

Eastern Workings. The eastern or ''low-hill'' workings consist of several open pits on the summit of the ridge east of the steep valley. The largest is about 200 by 250 feet, and like the western pit, was made entirely by bulldozer. About 400 long tons of ore averaging 55 percent manganese were produced from these workings. The ore lies immediately above a bed of massive jasper in a lens of thin-bedded red or white chert of the Franciscan group. The average strike is N. 75° W.; the dip 55° N. The chert is everywhere folded and contorted, especially against and around the massive jasper. Both the ore and the jasper appear as broken and discontinuous masses. In the northeast edge of the pit, sandstone is exposed above the chert. To the northwest along the ridge, the chert lens becomes thinner and interfingered with sandstone.

The manganese ore obtained from the main pit was hard and blocky, though somewhat vesicular, and may be of the psilomelane type. The average grade was 55 percent manganese. It was associated with considerable powdery limonite and hematite, and in places showed cellular remnants of leached chert. The ore from a pit 1,000 feet northwest of the main pit exhibits a peculiar lamination in which layers of moderately hard oxide, an eighth to a quarter inch thick, are separated by papery or powdery vesicular partings. This ore was probably derived from a primary bed consisting of thin layers of manganese carbonate, or possibly manganese silicate separated by thin shaly or cherty bands. No primary ore was observed, and it is impossible to estimate what reserves of oxide ore may exist below the present pits. Probably there is some, but Mr. Dalessi reports that the ore visible in the bottom of the pits did not warrant the large amount of stripping that would have been necessary to obtain it.

No. 25. Thompson Deposit. (From files of U. S. Geological Survey, 1942.) In November 1942, C. C. Thompson of 7X Ranch, near Paso Robles, shipped 15 tons of ore containing 41.5 percent manganese to the Metals Reserve Company stock pile. A second shipment of 12 tons was rejected because of high content of manganese carbonate. The analysis of the second shipment gave 41.66 percent manganese; 1.5 percent iron; and 21.41 percent silica. The content of manganese carbonate was 22.02 percent. The deposit was not visited and no further information is available.

No. 26. Tobacco Creek Prospect. (By F. S. Hudson and G. H. Alvey, August 14, 1918.) The Tobacco Creek prospect is in the north center of sec. 2, T. 26 S., R. 8 E., on a mineral claim held by William Bodine of Cambria. It is 0.3 mile west of Tobacco Creek on the north side of a tributary to that stream at an altitude of about 1,900 feet. The locality is best reached by trail south from Bryson, Monterey County, a distance of 12 miles. Bryson is 25 miles by road west of Bradley on the Southern Pacific Railroad. The port of San Simeon lies about 15 miles southwest by an old road which crosses Pine Mountain by way of the Ocean View quicksilver mine. No work has been done at the prospect.

The manganese occurs in a massive bed whose maximum thickness is 28 inches. The bed is traceable for 20 feet, N. 45° W. along the strike. The dip is steep to the southwest. A bed of massive green chert forms the footwall and thin-bedded green chert, the hanging wall. The ore bed lenses out at the northwest end. The southeast end is not exposed. The unoxidized ore is a mixture of silica, pink carbonate, and a low oxide of manganese. The siliceous ore contains no carbonate that can be seen with the hand lens, and aside from a higher specific gravity resembles brown chert. Along fractures and joint planes and on the exposed surface of the outcrop, this ore has altered to a black, somewhat resinous material. A sample taken across the widest part of the bed carries 41.1 percent manganese and 22.2 percent insoluble. If this prospect were more readily accessible to rail or water transportation, a certain amount of development would seem advisable.

No. 27. Vollmer (Quintano) Prospect. (By F. S. Simons, April 1942.) The Vollmer prospect is in the NE¼ sec. 6, T. 29 S., R. 11 E. It is half a mile from the end of the road that branches off the San Lusito Canyon road at the Vollmer ranch. The property is owned by Ernest Vollmer of San Luis Obispo, and is 10 miles from the railroad at San Luis Obispo. This prospect was examined by Frank S. Hudson in July 1918. Since then two small open cuts have been made but no ore has been shipped and no recent work has been done. The ore occurs in thin-bedded red, brown, green, and white chert, the beds averaging about 2 inches in thickness. The chert body is 225 feet long. The ore bed is from 1 to 6 feet thick and is essentially continuous, but the good ore is sporadic in occurrence, and commonly is concentrated in fractures. The high-grade ore is manganese oxide, the remainder manganiferous chert. The high-grade ore tends to be near the crest of the anticline where the bed is 2 feet thick. An analysis of the high-grade ore gave 45 percent manganese, 1.7 percent iron, 27 percent silica, and 0.08 percent phosphorus. The average ore contains less than 25 percent manganese.

The prospects of finding much good ore are not favorable. The nearness of the serpentine makes it probable that the ore is cut off at a shallow depth, and only a small part of the ore bed contains shipping ore. About 5 tons of 25 percent ore is piled on the dumps.

No. 28. Welch Mine. (By F. S. Hudson and G. H. Alvey, July 27, 1918.) The Welch mine is in the NW¼SE¼ sec. 34, T. 30 S., R. 11 E. It is on the east side of a canyon which runs north half a mile to join Clark Valley. The distance by road to San Luis Obispo is 13 miles. Operations have been carried on by the Noble Electric Steel Company by means of a sublease from Watson, Williams, and Hazzard, who in turn lease from Mr. Welch, the owner of the land.

An elongate body of chert makes up the prominent ridge on which the mine is located. The general strike is N. 70° W. The ore occurs within this chert body on the contact between a heavy bed of yellow chert and thin-bedded chert and shale. The ore is believed to occur at one stratigraphic horizon, the present position of the various ore bodies being due to folding and faulting.

The lowest tunnel in which ore has been found is known as No. 2 level. Here a tunnel 800 feet in altitude runs S. 35° W. for 120 feet along the ore, which dips 70° E. To the east is a bed of yellow massive chert; to the west is thin-bedded chert. The ore has been stoped to the surface for one-third the length of this tunnel, and 3 to 4 feet of good ore is said to occur in the floor of the tunnel. The ore in the face of the tunnel about 25 feet beyond the end of the stope has pinched down to a bed only a few inches wide. Though the ore here is of low grade, it looks like a good ''leader''. Some 200 yards southeast of No. 2 tunnel, the ore has been found at several levels: the No. 3 level, altitude 936 feet; No. 4 level, altitude 970 feet; and along the outcrop, altitude, 1,000 feet. These levels open up a fairly continuous ore bed striking N. 40°-70° W., and dipping north at a high angle. The continuity of the ore has been considerably disturbed by cross faults. The ore bed varies from 1 foot to 4 feet in thickness. To the north of the ore is thin-bedded red chert; to the south is a massive bed of yellow chert seamed with quartz. Most of the ore lying between level No. 3 and the outcrop has been stoped. On a previous visit to the mine, some of the ore in level No. 3 was seen to consist of brown manganese oxide, hausmannite(?), intimately associated with light brown siliceous ore and manganese carbonate. The ore being mined near the outcrop in July 1918 consisted almost entirely of the brown oxide.

As of July 27, 1918, a tunnel 450 feet north of the last described workings, at an altitude of 724 feet, had been driven 172 feet, mostly through sandstone and shale. The tunnel apparently would have to be driven at least 150 feet farther in order to reach the ore zone. Another tunnel was being driven at that time to cut the ore below level No. 2. The face was in brecciated yellow chert at the time of visit, and no definite prediction could be made as to when and where the ore would be struck.

Active mining was begun in January 1918. The first ore was shipped in March. Five cars were shipped before May 1, and 19 cars since then, making a total production of about 1,150 gross tons. The last few cars have assayed manganese, 47 percent; silica, 16 percent.

The Welch mine was visited by F. S. Simons in April 1942, who reported that the property was idle and the workings caved. Total production for World War I was 2,916 tons.

No. 29. Young Deposit. (From files of U. S. Geological Survey, 1943.) A deposit owned by Monte Young of Cambria is said to have shipped ore in 1943 to the Metals Reserve Company stock pile at Tracy. The deposit was not visited and its location is not known.

SANTA BARBARA COUNTY

No. 1. Byrne and O'Donnell Prospect. (By F. S. Hudson, June 21, 1918.) A manganese prospect is on one of the Byrne and O'Donnell chrome claims in the NE¼SW¼ sec. 8, T. 7 N., R. 29 W. A prominent outcrop of red, green, and brown chert occurs here. Most of the chert is thin-bedded but within it is a 6-foot bed of massive red chert. The dip of these beds is about 45° NW. All the chert carries stains of manganese oxide, but the greatest showing of manganese is on the south side of the heavy bed where siliceous red-brown manganese ore is present. A sample taken from loose blocks of siliceous brown oxide ore, below the outcrop, carried manganese, 48.6 percent; and silica, 18.2 percent.

No. 2. La Laguna Rancho. (By F. S. Hudson, June 22, 1918.) An area of thin-bedded chert of green and brown color occurs in the NW¼NE¼ sec. 33, T. 8 N., R. 30 W., on La Laguna Rancho. Nothing was seen here to encourage prospecting as the only manganese present occurs as thin coatings on weathered chert. A prospect pit in the west center of sec. 11, T. 7 N., R. 30 W., exposes intensely brecciated recemented rock of greenish color. This rock is of doubltful origin but looks more like altered basalt than chert. Within this material occurs a large block of jaspery material of bright vermilion color. A few manganese stains are found along fractures. A few feet to the south loose blocks of manganese ore of fair grade have been found. The prospects for manganese ore at this locality are poor.

No. 3. Morey Prospect. (By F. S. Hudson, June 22, 1918.) Large blocks of manganese ore occur on the summit of a knoll on a sharp northeast-trending ridge in the NW¼SW¼ sec. 18, T. 7 N., R. 29 W. A train of float runs from this point to the south as far as Morey Canyon. This deposit is said to be on the land of a Mr. Morey. Blocks of ore, together with large angular blocks of thin-bedded chert occur in a matrix of soil which rests on well-bedded boulder beds that appear to be of Tertiary age. The boulder beds dip to the northeast at a gentle angle. About 300 yards to the northeast the general slope of the country increases. Beyond this point the rocks are Franciscan in age. About 10 tons of low-grade ore occur here.

The most probable explanation of this manganese occurrence is that Tertiary beds have been faulted down against Franciscan and that a now degraded fault scarp contained a lens of manganese ore from which large blocks were dropped onto the adjacent surface of Tertiary beds. Other less probable explanations are: (1) it is ore in place in an inlier of the Franciscan group; (2) it is an erosional remnant of a thrust block of the Franciscan group.

SANTA CLARA COUNTY

Geology of the Black Wonder Area[1]

The Black Wonder area in T. 6 S., R. 5 E., in the southeast part of Santa Clara County and the southwest part of Stanislaus County, contains a large number of manganese deposits within an area of 20 square miles. These deposits were worked sporadically during World War I, but in World War II they yielded considerable ore, not only for metallurgical purposes but also for the battery plant at Patterson, 30 miles east of the area. The U. S. Geological Survey and the U. S. Bureau of Mines examined this area in detail in 1941 and 1942. The general setting of the manganese deposits is shown in plate 11.

The manganese deposits are in lenses of white chert which lie in a belt of Franciscan rocks of Jurassic (?) age, which form the core of the

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[1] By Frank S. Simons and Parker D. Trask.

Diablo Range. The Franciscan group in this region consists of feldspathic sandstone, shale, chert, altered volcanic rocks (greenstone), basic plutonic rocks, glaucophane, and related schist. The sandstone and shale are the most plentiful rock types. They are found in two northwesterly trending zones separated by a body of basic rocks—gabbro, peridotite, and dunite, largely altered to serpentine. These plutonic rocks intrude the sandstone and shale. The body of sandstone and shale in the southwest part of sec. 32, along the ridge west of the south fork of Beauregarde Creek is bordered by a large mass of glaucophane and related schist.

The sandstone in the Black Wonder area is a greenish-gray, fairly uniformly medium-grained, moderately thick-bedded feldspathic rock containing particles of ferromagnesian minerals that are now largely altered to chlorite. Relatively little mica is present. The sandstone in many places contains shale fragments, some of which are half an inch in diameter. These shale fragments impart a somewhat platy cleavage to the rock. In places the sandstone has been altered hydrothermally to such an extent that in the field it can scarcely be told from greenstone. The sandstone is much jointed and fractured and some of it is so sheared that the bedding is obscured. In places it is cut by numerous intersecting white quartz veins an eighth to a quarter of an inch thick. The sandstone weathers readily and is not well exposed except along streams. Where weathered, it is buff or brownish gray in contrast with grayish green in the fresh rock. The shale is found mainly in thin beds between sandstone or chert. The shale associated with the chert is red, dark brown, or purple; and the shale found with the sandstone is gray, green, buff, brown, or black.

Chert, the host rock for the manganese, is in lenticular zones in the sandstone and shale. The chert grades into sandstone or shale with a rate of thinning in places as much as 1 foot in a distance of 2 feet. As contrasted with the chert of the Ladd-Buckeye area to the north where some bodies are more than 1,000 feet thick, and maximum thickness of chert lenses in the Black Wonder area is 250 feet. Some of the manganese deposits are associated with chert less than 100 feet thick.

The chert generally occurs in beds 1 to 4 inches thick, separated by beds of shale of from $\frac{1}{8}$ to 1 inch thick. The individual chert beds, like the zones in which they occur, are lenticular, but they tend to terminate bluntly rather than feathering out to a knife edge. In many places the chert beds are contorted fantastically. Some of the chert beds, particularly those in which manganese is found, are massive and are more than 10 feet thick. These massive beds commonly form prominent outcrops. Some of them are traversed by a network of quartz veinlets. Other massive beds are hard and dense at the surface of the ground, but at depth are soft and punky.

The range in color of the chert is large. The thin-bedded chert commonly is buff, and less commonly red or chocolate. The massive chert is white. Some of the chert near greenstone bodies is green. The manganese is associated only with white chert in this region, but in some other areas of Franciscan rocks it is also found with red and brown chert.

The chert, particularly the thin-bedded, is jointed and fractured on a small scale. The fracture planes commonly are perpendicular to the bedding, and are so prominent that they may give a false impression of stratification. The joint surfaces in many places are coated with thin films of manganese oxide.

The greenstone, which is an altered dacite or andesite, was observed in two places: one along the north fork of Beauregarde Creek in sec. 28, and the other near the Black Mike claim (Stanislaus 2) in sec. 14. In places the greenstone is vesicular, which suggests that some of it is derived from flows; but on Beauregarde Creek where well exposed, it is intrusive. At the east end of the Cottonwood claim (Santa Clara 11) the greenstone cuts bementite and rhodochrosite in chert, apparently without altering these minerals. The primary manganese minerals therefore are earlier than this particular greenstone.

The plutonic rocks that intrude the sandstone and shale in the northeast part of the area have been described by Wells, Hawkes, and Wheeler.[2] These rocks are largely altered to serpentine, and they contain deposits of chromite on Adobe Creek and of magnesite on Red Mountain. They do not seem to be related to the manganese in the Puerto Creek area, although in the Antonia deposit (Santa Clara 3) in sec. 32 to the southwest, alteration associated with serpentine has profoundly modified the chert in which the manganese is found.

Glaucophane and associated schists are found only in the southwest part of section 32. The usual types of schist of the Franciscan are present: glaucophane, quartz-albite, lawsonite, chlorite, and actinolite. At the Antonia claim a large block of magniferous chert near the east border of the schist mass, adjacent to a serpentine contact, has been partly recrystallized to quartz-amphibole schist in which bementite and rhombs of manganese carbonate have been observed.

The regional strike is northwest. Most of the beds dip 45° to 70°. Exposures are so poor that the structure cannot be ascertained with certainty, even in areas where trenches have been dug. In places, particularly in the Jones mine (Santa Clara 19), the beds have been badly broken by faults, but the displacement of most of the faults is less than 50 feet. At this locality most blocks larger than 6 inches in diameter have been fractured. In other areas the strata continue for at least 100 feet without being broken. A zone of chert extends almost uninterruptedly, except for minor faults, from the Jones mine to the Murmac prospect, along the ridge forming the boundary between Santa Clara and Stanislaus Counties. Minor folds lie on the flanks of this ridge.

The manganese ore is in irregular lenses in white chert. The high-grade ore consists almost entirely of manganese minerals, and the low-grade ore is an intimate mixture of chert, quartz, and manganese minerals. This second type, called stockwork ore, grades into the first, and a transition zone of it borders the high-grade bodies. The primary mineral in the high-grade ore is gray rhodochrosite, which looks like dirty loaf sugar. The average diameter of the mineral grains is about one-sixteenth inch. The primary minerals in the low-grade ore are honey-brown manganese silicate and rhodochrosite. This honey-brown mineral looks like bementite. Identification has not yet been verified by means of X-ray diffraction patterns, but the mineral is designated as bementite in this section of this report. The color grades from honey-brown to light gray or to white, which suggests that chert grades into bementite and that the bementite is of sedimentary origin. In places, both chert and bementite contain spherical or ellipsoidal segregations of rhodochrosite about a sixteenth to a quarter inch in diameter. In other places, rhombs of carbonate, presumably rhodochrosite, of similar size, are enclosed in chert.

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[2] Wells, F. S., Hawkes, H. E., and Wheeler, D. P., Chromite and quicksilver deposits of the Del Puerto area, Stanislaus County, California: U. S. Geol. Survey Bull. 936, pp. 79-110, 1942.

Near the surface of the ground, the primary minerals have been oxidized, but the relationship of the various oxides to the primary minerals is obscure. The manganese in most places has migrated very little, though cracks and fissures near the manganese deposits commonly are stained with thin films of manganese. The depth of oxidation does not correspond closely to the surface topography, as can be seen in the winze at the Jones mine (Santa Clara 19). The boundary between primary and oxide ore lies at a depth of 50 feet in the winze, whereas in the drift northward from the winze into the heart of the mountain at a level of 63 feet, the boundary is below the floor of the drift. The change from oxide to carbonate in the winze takes place mostly within 5 feet, but long tongues of oxide extend along fractures for at least 25 feet below the main zone of change.

The ore in several prospects, but particularly at the Jones mine, is cut by an interlocking network of thin quartz veins. In the oxidized zones the presence of these quartz veins imparts a box-work appearance to the ore. In the Ladd-Buckeye area to the north in San Joaquin and Stanislaus Counties, these quartz veins are associated with pyrite and a mineral that looks like cinnabar. This relationship suggests that the veins are of hydrothermal origin. At the Jones group, the rhodochrosite is very even-grained and gives no indication of stratification, which suggests that the hydrothermal action that formed the quartz veins also may have reworked the rhodochrosite. In this area the manganese oxides have penetrated the wall rock more than in places where the quartz veins are less plentiful.

Many of the high-grade deposits have a hanging wall of massive white chert and a footwall of thin-bedded buff chert. A similar relation was noted in the Ladd mine (San Joaquin 5) to the north. As the strata do not seem to be overturned, the ore bodies are interpreted as lying at the base of massive beds of white chert. Many of the better lenses of ore terminate bluntly against white chert along the bedding, the massive white chert occupying space that would be taken by ore if the ore continued. The primary minerals, therefore, seem to have been formed by the same general processes that formed the massive white chert, but under special local environmental conditions. The detailed stratigraphic mapping in the Ladd-Buckeye area suggests that these special conditions prevailed in basins on the sea floor where the oxygen content of the water was particularly low.

Description of Manganese Deposits

No. 1. Acme Lode Claim. (By Parker D. Trask and Frank S. Simons, October 1941.) The Acme Lode claim is on the north side of Beauregarde Creek in the NW¼ sec. 30, T. 6 S., R. 5 E. (pl. 11, deposit 12). It is 1 mile east of the junction of the Puerto Creek road with the Livermore-Mount Hamilton road. The claim was located by James Renfrew, J. W. Bonsack, and Ralph Bolt, on January 18, 1941. Development consists of a shaft 3 feet deep, two open cuts, and five trenches. The ore bed is exposed for 125 feet, mostly in the bed of the creek. It strikes northwest and dips 40° to 75° NE. The average width is 3 feet and the maximum is 4 feet. The ore consists mainly of siliceous oxides in white chert, but in the creek bottom rhodochrosite is found. The grade varies, but is richest toward the southeast end, where it is of the order of 25 percent manganese. The ore at the north end is of low grade, probably about 4 percent manganese.

No. 2. Ala Mountain Mine. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 75, 1918.) The Ala Mountain mine is 26 miles southeast of Livermore in sec. 28, T. 5 S., R. 4 E. A body of manganese ore about 4 feet wide is exposed in an open cut and short tunnel. Some ore was hauled to Livermore prior to World War I. The Merchant Estate of Livermore is the owner.

No. 3. Antonia Claim. (By Frank S. Simons and Parker D. Trask, October 1941.) The Antonia claim is on the south side of Beauregarde Creek in sec. 32, T. 6 S., R. 5 E. (pl. 11, deposit 2). It was located by Matt Keller on February 25, 1940. The main exposure of manganese material is in a broken block of massive chert, 100 feet in diameter, known locally as the ''Big Blowout.'' Four small trenches have been dug around this body of chert. The deposit is of little economic interest for most of the manganese is in thin films of oxide or in disseminated manganiferous carbonate. The manganese content is approximately 10 percent. The chert is almost completely recrystallized to quartzite. The chert body is adjoined by serpentine derived from pyroxenite on the east, and by glaucophane, crossite, and related schists on the west. The chert exhibits contact metamorphic development of glaucophane, crossite, albite, garnet, and apatite common to the altered chert of the Franciscan group, as well as the very unusual development of abundant acmite and less abundant aegirine. This mineral assemblage indicates that considerable soda has been added hydrothermally to the chert.

No. 4. Avery Prospect. (From files of U. S. Geological Survey, 1918.) A deposit said to be owned by George D. Avery of Porterville is located 25 miles from Livermore in Santa Clara County. A sample of ore assayed 35 percent manganese and 12 percent silica. The exact location of the deposit is unknown.

No. 5. Billy Goat Prospect (Wasp-K.H.D.). (From files of U. S. Geological Survey, 1918.) A deposit known as the Billy Goat or Wasp-K.H.D. prospect is 25 miles southeast of Livermore in sec. 12, T. 6 S., R. 4 E. It is said to be owned by John Pattner of Livermore and to have produced 49 tons in 1917.

No. 6. Black Bear Mine. (California Min. Bur. Bull. 76, p. 75, 1918.) ''Black Bear Mine, 25 miles southeast of Livermore, is in sec. 34, T. 5 S., R. 4 E., near the summit of the west slope of the Arroyo Mocho Valley, at an elevation of 3100 feet. Interbedded lenses of manganese ore occur in the jasper, some of them being 3′ in thickness and fairly extensive. Development consists of several open cuts and tunnels. The property has been idle for several years. D. P. Doak, Rialto Bldg., San Francisco, is the owner.''

No. 7. Blackbird (Blackhawk) Claim. (By Frank S. Simons and Parker D. Trask, October 1941.) A claim presumed to be the Blackbird lies on the same ridge as the Mexican prospects (Santa Clara 30) in the northeast part of sec. 28, T. 6 S., R. 5 E. (pl. 11, deposit 6). The owner is M. E. Fisher. Two trenches expose a bed of siliceous manganese oxide 70 feet long. The maximum width is 4 feet and the average width 2 feet. The ore is discontinuous and variable in grade. In places it is found in pockets which range in size from 2 to 4 feet. The ore is richest at the south end where it contains as much as 30 percent manganese. The average grade is under 25 percent manganese. The ore body strikes northwest and dips 60° to 85° SW. It is terminated on the south by a fault and 22 feet north of the south end it is offset 8 feet by another fault. Prospecting for the continuation of the ore beyond the fault at the south end would be difficult because of the depth of overburden.

No. 8. Black Eagle Claim. (By Frank S. Simons and Parker D. Trask, December 1941.) The Black Eagle claim is on the south side of Beauregarde Creek 0.3 mile west of the May Be claim (Santa Clara 27), in the SE¼ sec. 28, T. 6 S., R. 5 E. (pl. 11, deposit 8). It was located by Mrs. Antonia Harris on July 16, 1940. It is leased to the Barker Corporation. Production to November 15, 1942, was 40 tons shipped to the General Dry Battery Plant at Patterson. Development consists of an area 300 feet long and 150 feet wide, which has been scraped with a bulldozer, and two open cuts. The U. S. Bureau of Mines has also opened two cuts along two of the ore bodies.

Ore is exposed in two places in the bulldozed area. At the discovery monument a mass of ore has a strike length of 40 feet. The ore is siliceous manganese oxide, very discontinuous and uneven in tenor. It is associated with greenstone and altered greenish sandstone, but the field relations are obscure. The bed strikes N. 30° W. and dips about 20° SW., but the dip is not clear. The greatest width of ore is 5 feet. Some of the high-grade ore is associated with greenstone and altered sandstone and is traversed by many quartz veinlets. It may have a hydrothermal origin, as silica is abundant and some of the nearby shale is chloritized, but too little development has been done to prove or disprove this.

About 125 feet southeast of the first exposure of ore is a body of high-grade ore 10 feet long and 4 feet wide, which the U. S. Bureau of Mines uncovered. The associated rocks are greenstone and altered shale, but the exposures are too poor to indicate the relationships. This body evidently is not connected with the ore to the northwest, as the intervening rocks are purple and buff shale. The best ore here may contain as much as 40 percent manganese. The ore at the main outcrop averages about 25 percent manganese. Further development should be done on the high-grade ore at the southeast end of the area, but lack of outcrops in the immediate vicinity would make additional prospecting futile.

No. 9. Black Horse Claim. (By Parker D. Trask and Frank S. Simons, December 1942.) The Black Horse claim is in the NE¼ sec 32, T. 6 S., R. 5 E., on the southwest side of Beauregarde Creek about 500 feet southeast of the junction of the north and south forks (pl. 11, deposit 3). The claim was located by Mrs. Antonia Harris on November 28, 1939. The claim is leased to the Barker Corporation. The production to November 15, 1942, was 40 tons, shipped to the General Dry Battery Plant at Patterson.

Three open cuts and two trenches delimit the ore body. The ore is mainly low-grade oxide with relatively high silica content, but there are a few pockets of high-grade oxide, the largest of which is 4.5 feet in diameter. The manganese ore is confined to a bed which strikes N. 25°-45° W. and dips 65° to 85° N. The hanging wall is red shale overlain by massive white chert, and the footwall is massive white chert stained with manganese oxide. The ore body is exposed for 120 feet and attains a maximum width of 5 feet. It pinches out to the northwest. The southwest end is not exposed, but where last seen has thinned to 2 feet and probably does not continue much farther. The grade of the ore varies considerably along the strike but averages about 20 percent manganese.

No. 10. Cedar Tree Claims. (By Frank S. Simons and Parker D. Trask, December 1941.) The Cedar Tree claims are on the south side of Beauregarde Creek in sec. 33, T. 6 S., R. 5 E. (pl. 11, deposit 1). One claim in the name of Mrs. Antonia Harris extends 1,100 feet east of the discovery monument and the other in the name of Matt Keller runs 1,200 feet north from the same discovery monument. Both claims were located January 20, 1941. Development consists of five trenches and one cut. The cut is 50 feet long and 10 feet wide. The ore body consists of disseminated oxide in white chert. It is exposed for a distance of 50 feet and has a maximum width of 2 feet. It is displaced by several faults of small throw. On the north side, the ore body lies nearly parallel to the surface of the ground, dipping 15° N., but on the south side it is folded into a sharp anticline and presumably thins out a short distance beneath the surface of the ground. The footwall is shaly chert and the hanging wall is thin-bedded brown chert. Above the footwall is at least 4 feet of low-grade ore. The manganese oxides in this ore zone probably are derived from the overlying ore body.

No. 11. Cottonwood Claim. (By Frank S. Simons and Parker D. Trask, December 1942.) The Cottonwood claim (pl. 11, deposit 10) is on the north side of Beauregarde Creek in the SW$\frac{1}{4}$ sec. 28, T. 6 S., R. 5 E., 0.3 mile west of the Triple Jump claim (Santa Clara 4). It was located by Matt Keller, June 25, 1940, and is leased to the Barker Corporation. Production to November 15, 1942, was 40 tons sold to the General Dry Battery plant at Patterson. An area 300 feet long and 100 feet wide has been scraped by a bulldozer, and in addition four cuts and trenches have been opened. Ore is exposed in two places. At the northwest end of one open cut, a series of blocks of siliceous manganese oxide, 2 to 5 feet wide, are exposed throughout a distance of 40 feet. The trend of the blocks is N. 30° W., and the dip is nearly vertical. These blocks may be faulted segments of a single bed. They are associated with greenstone and are cut by many small quartz veins. Some of the adjacent shale has been chloritized. The relation of the greenstone to the manganese material is obscure, but the chert in which the manganese is found has been altered hydrothermally. The grade of the ore varies but the average is about 35 percent manganese.

Another ore body, 10 feet long and 5 feet wide, is exposed at the southeast end of the open cut. The ore strikes north and is nearly vertical. It is adjacent to a greenstone body 5 feet thick, and in one place it is cut by a thin stringer of greenstone, which seemingly has not altered the manganese minerals. This bed is stratigraphically distinct from the first bed, as the intervening rocks are well exposed in the cut and no fault is apparent. The grade likewise is higher; the average is 40 percent manganese. The extent of this ore body has not been determined as it strikes into the hill, but it warrants further testing because the width and grade are relatively high.

No. 12. Davenport Prospect. (By E. F. Davis, October 1, 1917.) The Davenport prospect is owned by J. W. Davenport of Livermore. It is about 500 feet south of the center of the north line of sec. 27, T. 5 S., R. 4 E., about half a mile east of the Arroyo Mocho road. A lens of massive ore 5 feet thick is enclosed in red radiolarian chert and shale. The beds strike N. 70° W., and dip 65° S., parallel to the ore body. The ore is highly siliceous and is cut by numerous veins of quartz.

No. 13. Davenport and Smith Property. (By E. F. Davis, October 1, 1917.) A prospect owned by Davenport and Smith of Livermore is half a mile off the Arroyo Mocho road, 25 miles southeast of Livermore, in the NE¼ sec. 27, T. 5 S., R. 4 E. It lies on the south slope of the ridge that occupies this quarter section. The ore body is exposed in a number of workings. At the extreme northwest end of the property, an inclined shaft follows the ore bed down dip for 25 feet. Southeast of this point the ore body is exposed in a series of open trenches. Ninety feet southeast of the shaft is a drift which runs nearly northeast along the strike of the ore body for a distance of 35 feet. Southeast of this drift are other trenches along the course of the ore body. At the extreme southeast end of the property, 300 feet from the shaft, a short tunnel exposes 5 feet of ore.

The ore body is a massive bed of siliceous manganese oxide. It strikes N. 50° W., and dips from 25° to 75° SW. It is considerably broken by minor shearing so that the relations to the country rock are not clear. Where undisturbed it is parallel to the bedding of the enclosing chert and shale. The thickness of the ore body averages 2.5 feet. The maximum thickness is 6 feet. In the shale are several thin beds of siliceous ore which have the same relation to the shale that chert ordinarily has. These beds are about 3 inches in thickness and are composed of the same material that is found in the larger ore body.

No. 14. DeForest Prospect. (Modified slightly from original description in California Min. Bur. Rept. 13, p. 507, 1896.) A pocket of manganese ore is found in sec. 12, T. 7 S., R. 4 E., in a ravine 3 miles south of DeForest, at an altitude of 2,500 feet. The property is undeveloped, but is said to contain 57 percent manganese.

No. 15. Doak No. 2 Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76. p. 77, 1918.) The Doak No. 2 prospect is in the Red Mountain district, 25 miles southeast of Livermore on the Camp Bessie road, in sec. 22, T. 5 S., R. 4 E. A few open cuts and short tunnels have been driven on massive outcrops of manganiferous chert, exposing a vein of manganese ore said to be 4 feet in width. A few tons of ore were produced from this deposit, but it is now idle. D. P. Doak of San Francisco is the owner.

No. 16. Fable Mine (Camp Bessie). (By F. S. Hudson, October 1, 1917.) The Fable or Camp Bessie mine is said to be the property of Tom Green. It is about 300 yards west of the Arroyo Mocho road, 26 miles southeast of Livermore in the SW¼NE¼ sec. 34, T. 5 S., R. 4 E. A small gulch passes a few yards south of the mine and enters the Arroyo Mocho a few hundred yards to the east. The approximate altitude of the mine is 2,850 feet. A tunnel has been driven N. 40° W. into the hill. It follows the ore body for 30 feet to a fault which strikes N. 20° E., and cuts off the ore bed. The tunnel turns here and follows the fault for 30 feet, at which point the ore body was again found. A drift follows the faulted portion of the ore for 10 feet in a direction N. 70° W. A considerable amount of ore has been removed by open cut stripping just outside the mouth of the tunnel, and a narrow stope connects the tunnel with the surface.

The ore body is a massive bed of oxide ore lying conformably within a series of thin-bedded chert and shale. The rocks dip 45° to 65° S. The ore consists of manganese oxides and silica. Most of the ore is compact, but much of it is cellular; the irregular cavities commonly being lined with drusy masses of reddish iron-stained material. By hand sorting, pieces of ore free of apparent silica, up to 3 inches in diameter, may be obtained, but considerable iron is present throughout. Some process of enrichment seems to have acted, which removed silica but left the iron and manganese behind.

That part of the ore body which is east of the fault has been exposed for about 75 feet along the strike, and for 25 feet above the workings. Its thickness ranges from 4 to 6 feet, averaging about 5 feet. That part of the ore bed which has been shifted to the north on the west side of the fault is exposed for 15 feet along the drift and averages 2.5 feet in thickness. Examination of the exposures in the creek bed about 60 feet west of the face of the drift, showed only sandstone, apparently because another cross fault displaces the ore bed between the face of the drift and the creek bed. At the time of the examination, work was being started to cut the extension of this body at a point about half way between the fact of the drift and the creek, by crosscutting from near the mouth of the tunnel.

No. 17. Frankel Prospect. (By Spangler Ricker, 1941.) The Frankel prospect is 6 miles east of Berryessa in T. 6 S., R. 2 E., on the Frankel Ranch. The deposit consists of stains of manganese oxide, and is of little value.

No. 18. Great Expectation Mine. (By E. F. Davis and F. S. Hudson, September 27, 1917.) The Great Expectation mine is on property of E. P. Newhall of Livermore, in sec. 36, T. 5 S., R. 4 E., on one of the head waters of Colorado Creek. It is reached by following the Arroyo Mocho road from Livermore for 29 miles, where the road leaves Colorado Creek to climb over a low divide into the drainage of San Antonio Creek. A branch road goes up Colorado Creek from this point to Newhall's camp, about 3 miles distant. Two definite zones of ore are exposed on the property; these are about 100 feet apart stratigraphically. The northeasterly and lower of these zones has been worked the most. A short drift follows the ore and a crosscut was being driven to intersect the ore beyond the face of the drift. The work on the southwest body consists of a small amount of stripping to remove surface rock.

The northeast ore body is a massive lens, lying within bedded radiolarian chert and shale, parallel to the bedding. The general strike is N. 70° W., and the dip 45° S. The chert above the ore bed is white and pink. In places it is thin-bedded, at other places massive, the change being accomplished by a wedging out at the ends of chert lenses. The ore body is underlain by thin-bedded green shale and chert. The contact of the ore against the enclosing chert is sharp.

The ore body for the most part is composed of manganese oxide and of patches of residual silica. However, carbonate ore is found in the bottom of the drift. The carbonate has been oxidized along joint cracks so that ore breaks out in blocks apparently composed of oxide throughout, but on cracking these blocks the unoxidized kernel of pink or brown carbonate is found. The carbonate is composed of gray ore, pink crystalline rhodochrosite, and a brown carbonate, determined in the field to be siderite. These minerals show a rude alteration in bands. Locally the siderite occurs as spherules in the midst of the other carbonates. The silica content of the ore varies greatly.

A rather interesting feature of this occurrence is the presence of small spherules of rhodochrosite in some of the bedded chert on the hanging-wall side of the ore body. As suggested above, the oxidation of such spherules may account for the slight manganese oxide staining in the wall rocks. In this ore body the carbonate ore lies 5 to 10 feet above the bed of the creek, which is dry in the summer. The level of the ground water is uncertain, but the upper limit of the carbonate is certainly above the present ground-water level. The ore body is exposed from near the creek level to a point about 60 feet to the northwest, where it lenses out. Its maximum thickness is 2.5 feet, gradually thinning to zero at the northwest end.

The southwestern ore body is a massive bed of chert enclosed in bedded chert and shale with apparent conformity. The bed has altered in part to a manganese oxide ore, carrying skeletons of residual silica, and in part to a mixture of manganese oxide and of silica, clearly pseudomorphous after a chert carrying spherules of manganese carbonate. This bed ranges from 7 to 10 feet in thickness and is exposed in several places for a distance of 300 feet along the strike, which swings from N. 60° W. at the southern end to N. 20° W. at the northern end. The dip ranges from 45° to 65° SW.

Insufficient work has been done on this bed to permit estimating either grade or tonnage. A picked sample ran 40 percent manganese and 16 percent silica. Exploration might prove the presence of considerable amounts of ore here.

No. 19. Jones Deposits. (By Frank S. Simons and Parker D. Trask, December 1942.) The Jones group of prospects in the NW¼ sec. 27, T. 6 S., R. 5 E. (pl. 11, deposit 20), are the largest and best explored in the Black Wonder area. They have been operated by the Western Manganese Company. Of the five deposits (pl. 12), deposit I has been explored the most extensively. A tunnel 50 feet in length was driven before 1910. These workings were extended in the winter of 1940 and the spring of 1941, and approximately 400 tons of high-grade oxide ore was shipped. Subsequently a winze and additional workings at a depth of 63 feet were opened. The other deposits have been prospected by numerous trenches, as shown on plate 12.

The geology of these deposits is shown on a topographic map (pl. 12). As the outcrops are poor, the position of the contacts and the structure of the rocks could be ascertained only in a general way. A body of chert 250 feet thick lies within a sandstone sequence. The sandstone beneath the chert seems to grade into thin-bedded shale and chert toward the west. The general strike is northwest and the dip is 50° to 80° SW. A few minor folds and wrinkles are present. The structure in the main level of the Jones mine at deposit I is complicated, as illustrated by plates 13 and 14, but at depth in the winze, the strata are persistent for 100 feet, except for one horizontal fault having a displacement of 3 feet.

The ore at the Jones group of prospects is found in massive white chert embedded in thin-bedded red chert and shale. It is of three types. In the Jones mine, it consists of high-grade massive black oxide in beds 3 to 5 feet thick. At a depth of about 50 feet in this mine, the black oxide grades into rhodochrosite. In the other deposits the ore is low-grade siliceous black oxide. At deposit I there are two and probably three ore bodies within a stratigraphic range of 35 feet (pls. 13 and 14). The ore body that yielded most of the ore is folded into a tight anticline, and is cut by numerous faults. This faulting has caused the ore to occur in blocks. The general trend of the axis of the anticline is N. 60° W. The ore in the west limb of the anticline does not extend beyond a depth of 60 feet below the floor of the adit, as the east drill holes at that level in the winze did not disclose manganese ore. The extent of the east limb of the anticline is unknown.

About 25 feet northeast of this ore body, a small amount of manganese oxide was taken from an open cut. The ore body here pinches out with depth, and almost certainly is not connected with the main ore body in the mine.

Ten feet stratigraphically above the main ore body is another lens of ore, which ranges in width from 3 to 5 feet. It terminates bluntly in the roof of the main workings. Approximately 75 tons of ore have come from this lens. The lens has been followed downward in a winze to a depth of 85 feet and at this depth shows no indication of becoming thinner; so it presumably must continue for at least an additional 25 feet. The ore was followed for 145 feet in the two drifts at the 63-foot level, before it pinched out. The probable limits of the ore body as defined by the exploratory work are shown in plates 13 and 14. The outline is roughly elliptical. The major axis is 155 feet in length, and the minor axis 115 feet. The ratio of the two axes is 1.3 :1, and the ratio of the long diameter to maximum thickness is 31 :1.

Deposit II is the longest ore body in the Black Wonder area. It can be traced in a northwesterly direction for 310 feet though its course is sinuous and it is offset by several faults having displacements of less than 50 feet. The dip is nearly vertical. The average thickness is 2.5 feet, and the maximum thickness is 6 feet. In one trench the walls of the ore body expand downward, which suggests that the lens may get wider with depth. It probably does not extend much beyond a depth of 60 feet, for the drill hole into the wall of the winze at a depth of 60 feet in deposit I, encountered only 2 feet of low-grade manganese ore at a distance of 30 feet from the winze. This zone of low-grade manganese may represent the downward continuation of deposit II, for on the surface of the ground, deposit II lies 50 feet stratigraphically above the west ore body in deposit I. The ore in deposit II varies considerably in grade, but the average is of the order of 20 percent manganese.

Deposit III crops out in two places 30 feet apart, and presumably is continuous between these two exposures, except for minor faults. The strike is northwest and the dip nearly vertical. About 2.5 feet of high-grade manganese oxide are seen in a small drift and crosscut at the southeast end of the ore body. At the north end the lens is 4.5 feet wide. The walls are slightly fractured, but they diverge downward, which suggests that the surface exposures may be the upper part of a lens. Hence, a considerable tonnage of ore may be present. The average grade is about 40 percent manganese.

This deposit illustrates the desirability of exploring manganiferous lenses in massive chert. At the outcrop the ore was only 3 inches wide; at a depth of 4 feet it was 4.5 feet wide; and presumably below it is thicker. Apparently the surface exposure was just the tip of an ore body, just as at the west ore body in the Buckeye (Stanislaus 4) mine to the north.

Deposit IV, 40 feet south of deposit III, is 25 feet long and averages 1 foot in width. It probably is faulted at both ends. The average grade is about 35 percent manganese. Its position with respect to deposit III suggests that it is in the same stratigraphic zone as deposit II, which is less than 50 feet above the west ore bed at deposit I.

Deposit V is exposed in three cuts. It is 60 feet long and 2 to 5 feet wide. The bed is vertical at the west end and dips 60° S. at the east end. The wall rocks are shaly chert. The average grade is of the order of 25 percent, but some of the ore is high grade.

No. 20. Keller Brothers Prospect. (By E. F. Davis and F. S. Hudson, September 30, 1917.) Keller Brothers own a prospect of manganese ore on their ranch in San Antonio Valley in sec. 13, T. 6 S., R. 4 E. No ore has been produced and only a little development has been done. The prospect was not visited.

No. 21. Keller Mine (Dead Oak). (By Parker D. Trask and Frank S. Simons, December 1942.) The Keller mine is in the northwest part of sec. 32, T. 6 S., R. 5 E., and is operated by the Barker Corporation (pl. 11, deposit 4). The total production through 1941 was 756 tons, of which 54 tons was produced in 1940, and 702 tons in 1941. The 1942 production, up to November 15, was 938 tons, sold to the General Dry Battery plant at Patterson. The ore body trends N. 30° W. and is nearly vertical. Before the mine was worked the surface exposures consisted of a mass of black oxide 6 feet wide and 15 feet long. This body increased in size downward, and at a depth of 15 feet was 12 feet wide. Below a depth of 20 feet it began to thin and at a depth of 35 feet had almost pinched out. The maximum length of the ore in the workings was 35 feet. Later the mine was reopened and explored, and an ore body 6 feet thick was found at the bottom of a 125-foot inclined shaft, in a drift 60 feet long.

The ore body was separated from the wall rock, which consisted of leached thin-bedded chert. The presence of a fine clay zone along the walls suggests that the ore body is limited by faults. The chert zone in which the ore is found can be traced for 100 yards to the south, where it abuts into a large mass of glaucophane schist. On the north this chert body presumably is cut off by a fault within 50 feet of the mine, for in the road cut just north of the workings, sandstone lies in the projection of the ore body.

No. 22. A. M. Kelley Prospect. (By E. F. Davis, November 3, 1917). The A. M. Kelley prospect is on land owned by A. M. Kelley of Morgan Hill, in lot No. 16, map No. 3, Morgan Hill Ranch, in T. 9 S., R. 3 E. The property is not being operated at present. It is 2 miles southwest of Madrone on a low ridge at the head of a small flat-floored valley, tributary to the Santa Clara Valley. The prospect is 1,000 feet southwest of the Morgan Hill prospect (Santa Clara 32), southwest of the State Highway between Morgan Hill and Madrone. It is reached by a road which is within 1,000 feet of the prospect. Development consists of three open cuts.

The area west of Mr. Kelley's house consists principally of radiolarian chert, much of which is thin-bedded and of intrusive greenstone and serpentine. At several places the chert is brightly colored as a result of the contact action of these igneous rocks, and in some places it is stained with manganese oxide. The massive chert is cut by numerous fissures filled by oxides of manganese which form stains and impregnations. Only a few pounds of commercial ore are in sight here. Most of the material is too siliceous to be worked.

No. 23. Kelley Prospect. (By E. F. Davis and F. S. Hudson, September 29, 1917.) The Kelley prospect is owned by Ed Kelley, Mrs. Plattner and William Hampton. It is the NW¼ sec. 12, T. 6 S., R. 4 E., at an altitude of 3,220 feet, 31 miles from Livermore and 0.3 mile east of a branch road that runs up Colorado Creek to the Newhall mine. The ore is exposed in a small open cut for a distance of 15 feet. The ore body is enclosed within well-bedded radiolarian chert and shale which range in color from red to salmon, and the beds strike approximately east and dip 85° N. The ore body pinches and swells, ranging in thickness from 1 foot to 3.5 feet. It is massive and rather siliceous. A few small spherules of manganese carbonate embedded in a matrix of chalcedonic silica were seen. In many places the carbonate has been leached, leaving small round holes. All the ore exposed is siliceous and averages over 25 percent silica, with 5 to 15 percent iron, and 20 to 35 percent manganese.

No. 24. Lopez Prospect. (Modified slightly from original description in California Div. Min. Rept. 26, p. 14, 1930.) Alfred Lopez of Morgan Hill, reports a manganese deposit, probably in sec. 19, T. 9 S., R. 3 E., 1 mile west of Madrone Station on the Rainey Ranch.

No. 25. Mammoth Mine. (By E. F. Davis and F. S. Hudson, September 30, 1917.) The Mammoth mine is owned by H. H. Ballentine and is leased to John Plattner. It is 0.8 mile east of the Arroyo Mocho road 32 miles southeast of Livermore, on one of the tributaries of San Antonio Creek. The mine is in sec. 13, T. 6 S., R. 4 E., on land originally taken up as a mining claim by Mrs. Augusta Jones. Development consists of several open cuts all of which expose massive siliceous oxide ore. The ore bodies, although varying considerably in thickness, are thought to be parts of a single bed, dipping in general to the northeast, but warped and broken by minor faults. The thickness ranges from 3 to 6 feet. At one place a lens of chert 1.5 feet thick is interbedded in the ore body.

No. 26. Mateos Ranch Deposit. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 78, 1918.) The Mateos Ranch deposit is in sec. 8, T. 6 S., R. 2 E., 8 miles by road east of Milpitas, in Alum Rock Canyon, about 2 miles beyond the park. It is owned by John D. Mateos of San Jose. The manganese ore occurs in seams and pockets in chert. Considerable high-grade float is found in the canyon, and a few large boulders aggregating several tons in weight are in a small ravine near junctions with the main canyon. The ore, however, is intermixed with chert, and is low in grade. A tunnel was driven 40 years ago in the chert, and some high-grade ore is said to have been shipped. The tunnel is now caved. About 200 feet west of the tunnel and at the same elevation, an open cut was made in 1917, and about 40 tons of ore was shipped. The face of the cut is slumped, so that no ore is now exposed.

No. 27. May Be Claim. (By Frank S. Simons and Parker D. Trask, 1941.) The May Be claim is on the north side of Beauregarde Creek in the SE¼ sec. 28, T. 6 S., R. 5 E. (pl. 11, deposit 7). It was located by Mrs. Antonia Harris. Two cuts and a trench have been opened. The ore is exposed intermittently over a distance of 90 feet. The ore body strikes northwest and dips 25° NE. It probably is cut by faults at each end. The ore consists of low-grade oxides in massive white chert. The chert has been partly recrystallized and is cut by many quartz veins, suggestive of hydrothermal alteration. At the south end the manganese content is about 20 percent, and at the north end it is 10 percent or less.

No. 28. McCoy Deposit. (From files of U. S. Geological Survey, 1942.) A deposit controlled by C. L. McCoy of San Jose produced 15 tons of ore containing 31.6 percent manganese in November 1942. The ore was shipped to the General Dry Battery plant at Patterson. The location of the deposit is unknown but is believed to be near San Jose.

No. 29. McPherson Prospect. (From files of U. S. Geological Survey, 1942.) In 1942, J. L. McPherson delivered 8 tons of ore containing 35.9 percent manganese to the General Dry Battery plant at Patterson. The location of the deposit from which the ore came is not known.

No. 30. Mexican Deposits. (By Frank S. Simons and Parker D. Trask, December 1941.) The Mexican group of deposits is on the ridge between the two forks of Beauregarde Creek in sec. 27, T. 6 S., R. 5 E. The deposits are leased to the Western Manganese Company. Three ore bodies are present (pl. 11, deposits 5a, 5b, 5c). They lie along the regional strike over a distance of 1,000 feet, but do not appear to be at the same stratigraphic horizon. No claim notices were found.

At the first deposit (5a), a shaft has been sunk 35 feet in white chert, exposing a body of ore which is 2 feet wide near the surface and pinches out at a depth of 16 feet. The ore bed cannot be followed on the surface. The ore is black oxide in white chert, and the grade is of the order of 25 percent. The ore body strikes east and is nearly vertical. The north wall is thin white chert succeeded by thin brown chert. The south wall is white chert. By analogy with other deposits, the south wall should be the upper side of the deposit.

At the second deposit (5b), three open cuts expose a steeply dipping bed of siliceous manganese oxide ore, 3.5 feet wide and 75 feet long. The grade of ore varies along the strike, but the average tenor of manganese is 10 percent or less.

The third deposit (5c), is the most promising of the Mexican group. Six open cuts and a shaft 7 feet deep have been opened. The ore is siliceous manganese oxide in white chert. It is exposed in a lens 120 feet long and 6 feet in maximum width. The average width is 4 feet. The ore body pinches out at each end but widens downward. The strike is approximately north and the dip nearly vertical. At the north end it dips 75° E., and at the south end it dips 70° W. The ore body is offset by several small faults. The tenor varies along the strike. At the south end low-grade stockwork ore is present. The average grade is about 25 percent manganese. A second bed of siliceous manganese ore 2 feet wide and 25 feet long is found 20 feet south of the shaft. Its manganese content is about 10 percent.

No. 31. Miller Prospect. (From files of U. S. Geological Survey, 1918.) A deposit said to be owned by Caldwell and Albrecht and leased to a Mr. Miller, is reported to have produced 189 tons of ore containing 35 percent manganese and 12 to 17 percent silica in 1918. Its location is unknown.

No. 32. Morgan Hill Prsopect. (By E. F. Davis, November 3, 1917.) The Morgan Hill Prospect is on the Morgan Hill Water Works property in T. 9 S., R. 3 E. It adjoins the Kelley place on the north, and the workings are about 1,000 feet northeast of the A. M. Kelley prospect (Santa Clara 22). The deposit is on the northeast side of a small ridge which rises from a flat-bottomed valley. The workings are 2 miles southwest of Madrone and 500 feet from the road. The property is under lease to Eaton and Company, but is now idle. The workings have caved, so no good sections of the ore are exposed.

The lower part of the ridge on which the deposits occur is composed of serpentine and greenstone. The upper part consists principally of red chert and shale stained with manganese oxide. In this chert are several bodies of siliceous ore. In a few places the contacts have been sheared and faulted, and in two places greenstone is faulted against the ore. The ore is siliceous and probably exceeds 25 percent silica. The property produced 70 tons of shipping ore before it was abandoned.

No. 33. Mt. Hamilton Prospect. (By Spangler Ricker, October 1941.) The Mt. Hamilton prospect is near Lick Observatory in T. 7 S., R. 3 E. The owner is H. Backman of Berkeley. The ore body is exposed for a distance of 100 feet and has an average width of 7 feet. The grade is estimated to be 10 percent manganese. It has produced no ore.

No. 34. Murmac Group. (By Frank S. Simons and Parker D. Trask, 1941.) The Murmac group is in the westernmost series of deposits along the ridge between Santa Clara and Stanislaus Counties. The group is in the SW¼ sec. 21, T. 6 S., R. 5 E. (pl. 11, deposit 18). Five claims cover the area: Murmac, Murmac No. 1, Murmac No. 2, Patterson, and Chicago. The locators of the first three claims are not known. The owner of the Patterson claim is A. H. Jones, and of the Chicago claim, B. E. Cronkheit. In addition, two other claims have been located, one by Mary Lou Smith, December 2, 1940, and the other by Lee Neideffer, date unknown. The Murmac group of deposits produced 224 tons of manganese in 1941.

Five ore bodies are present in the Murmac group. Deposit 1 is the main ore body and lies at the west end of the area; deposit 2 is in the ravine 125 feet east of the east end of deposit 1; deposit 3 is on the hillside 100 yards east of deposit 2; deposit 4 is a large boulder of high-grade manganese on top of the main divide, 150 yards north of deposit 3; and deposit 5 is on the main divide 100 yards west of deposit 4. The relationship of these deposits to the surrounding rocks is shown in plate 15.

The West Coast Chrome Company opened deposit 1 in a cut 110 feet long and 10 feet deep. The U. S. Bureau of Mines sank one inclined shaft 25 feet down the dip of the ore body in this cut to where the ore was truncated by a fault, and another, 15 feet deep along the continuation of the ore body beyond the fault. In addition the U. S. Bureau of Mines dug 51 trenches.

The rocks consist of zones of chert and sandstone, which seemingly grade into one another within a very short distance. The region is faulted considerably, but most of the faults seem to have displacements of 25 feet or less. All the manganese deposits may lie at essentially the same stratigraphic horizon, but because of the poorness of the exposures no such inference is demonstrated. They could equally well occur at different horizons. At deposit 3 a massive white chert lens lies 35 feet above the ore bed. It is stained by manganese in places and may indicate the presence of a second ore zone, which is not well developed at this locality. Similarly deposit 2 may represent a zone a similar distance below deposit 1, but in view of the poorness of the exposures no definite statement can be made.

The ore beds are lenses in white chert. They are bedded deposits, though the surface exposures at deposits 1 and 2 are cut by numerous small quartz veins which suggest hydrothermal alteration. The ore consists of siliceous black oxides in white chert. The hanging wall is massive white chert and the footwall is buff thin-bedded chert. The ore bodies are lenticular and near where they pinch out, become relatively siliceous. The ore is of the stockwork type; the grade of the deposits is not high, except for deposit 4, which runs 45 percent manganese or better. At deposit 1 in the open cut the average grade is 35 percent manganese, and in the second shaft near where the ore pinches out it is 15 percent manganese. The grade at deposit 2 is variable but is of the order of 25 percent manganese. The other two deposits probably contain less than 10 percent manganese.

Deposit 3 contains the longest ore body, 125 feet in length. Its average thickness is 4.5 feet, and its maximum width is 6 feet. The ratio of length to maximum width is 21 : 1. The next largest ore body is in deposit 1. This ore body is exposed in the open cut for 110 feet, and it pinches out at each end. It can be traced down the dip in the inclined shafts for 40 feet before it grades out. The maximum thickness is 2.5 feet and the average is 2 feet. The ratio of maximum length to maximum thickness is 42 : 1, and the ratio of long diameter to short diameter is about 2 : 1.

Deposit 2 is exposed for 25 feet, and has a maximum thickness of 5 feet and a minimum of 2 feet. The ore body is seemingly offset by faults, but its continuation could not be found. In the cut 20 feet west of the ravine, the ore bed is duplicated by faulting. Deposit 4 is an erosional remnant of a once much larger body. It consists of a block of black oxide cut by many quartz veins. This block is estimated to weigh 150 tons. Deposit 5 consists of two beds 50 feet apart, each about 1 foot thick, exposed for a distance of 40 feet.

No. 35. Newsom Prospect. (By Frank S. Simons, October 6, 1942.) The Newsom prospect is in the SE$\frac{1}{4}$ sec. 26, T. 5 S., R. 4 E., 3 miles by road from the Arroyo Mocho road and 26 miles from Livermore. It is on land owned by Archie Newsom of Livermore, and leased by J. J. Kenney of San Francisco. A large area at the top of a low ridge has been thoroughly bulldozed. Blocks of siliceous ore are scattered over the entire area. The ore occurrences trend north.

At the south end an open cut 70 feet long exposes massive white chert carrying thin films of manganese oxide. About 25 tons of ore are in sight, averaging 15 percent manganese. A deep bulldozer cut across the south end of the working shows only thin-bedded red chert, striking N. 50° E., and dipping 30° SE., demonstrating that the white chert pinches out or is faulted off at the south end of the cut. The floor of the cut is not exposed, but it is thought that the manganiferous white chert does not persist to any great depth. The manganiferous chert can be traced for 30 feet beyond the north end of the cut, where a bulldozer trench shows that the ore body either lenses out in thin-bedded shaly chert or, more likely, is faulted off. The manganiferous chert crops out again 40 feet farther north, and can be traced more or less continuously for 80 feet, at which point a deep trench exposes an extremely faulted and brecciated mass of brown and white chert enclosing a very irregular ore body. The chert strikes N. 30° W., and dips 5° to 45° NE. The ore bed exposed in the north wall of the trench, 10 feet deep, apparently ranges from 2 to 11 feet in thickness. The ore here averages 20 percent manganese.

One hundred feet north of this trench is the last exposure of ore, in an old cut. Another trench here shows that the ore body is not persistent, and lenses out downward into shaly chert. Some of the ore in the cut contains 25 to 30 percent manganese, but probably little material of this grade is present. All the available evidence points to a rather shallow deposit, because at no place does the ore extend down for more than 10 feet. The country is highly faulted and brecciated, and much of the ore appears to have been concentrated in the brecciated parts of the chert.

No. 36. Pennsylvania Deposit (Noble Lease). (By E. F. Davis and Frank S. Hudson, September 30, 1917.) The Pennsylvania deposit is on the southwest side of San Antonio Valley in the SW¼ sec. 12, T. 7 S., R. 4 E., and is reached by the Arroyo Mocho road on a road through San Antonio Valley. It is owned by M. M. O'Day of San Jose and is under lease to the Noble Electric Steel Company. Work on this property has been discontinued recently. The production was 200 tons in World War I. The property has been explored in three places. The southern and northern workings are on a body of folded and contorted radiolarian chert 30 feet wide. The southern working is an open cut just south of a small creek, which crosses the body of chert. The ore lies in a massive bed which is enclosed in and is parallel to well-bedded radiolarian chert and shale. These beds vary from white and gray to pink and red. The average strike is N. 15° W., and the dip is 65° to 70° SW. Both strike and dip vary considerably because of the folding of the chert. The ore body ranges in thickness from 6 inches to 2.5 feet. It is siliceous and is mixed with much massive red chert. In places it contains small sheaves of an acicular green mineral not yet identified.

The northern working lies just north of the creek. Here small open cuts run into the chert and into the enclosing sandstone, but all the ore here has been removed, and to judge from the size of the workings no important ore body was found. One hundred and fifty yards down the creek, to the east of the chert body above described, a cut has been made along the contact of chert and sandstone. The creek below the cut is full of siliceous ore that has been blasted out and thrown into the creek. No ore remains in the workings and nothing is left to suggest the original relationships of the ore. The ore here is brown to black siliceous oxide. It leaves a porous residue on treatment with acid. The ore material is cut by veinlets of unidentified pale pink columnar hydrous silicate of manganese and contains masses of a granular pink manganese silicate, occurring in scaly aggregates which have not been identified. No commercial ore is left on this property and there appears no good prospect of discovering more ore, though additional prospecting might be justified on an outcrop of siliceous ore south of the south working. The outlook here is not promising because the ore is siliceous.

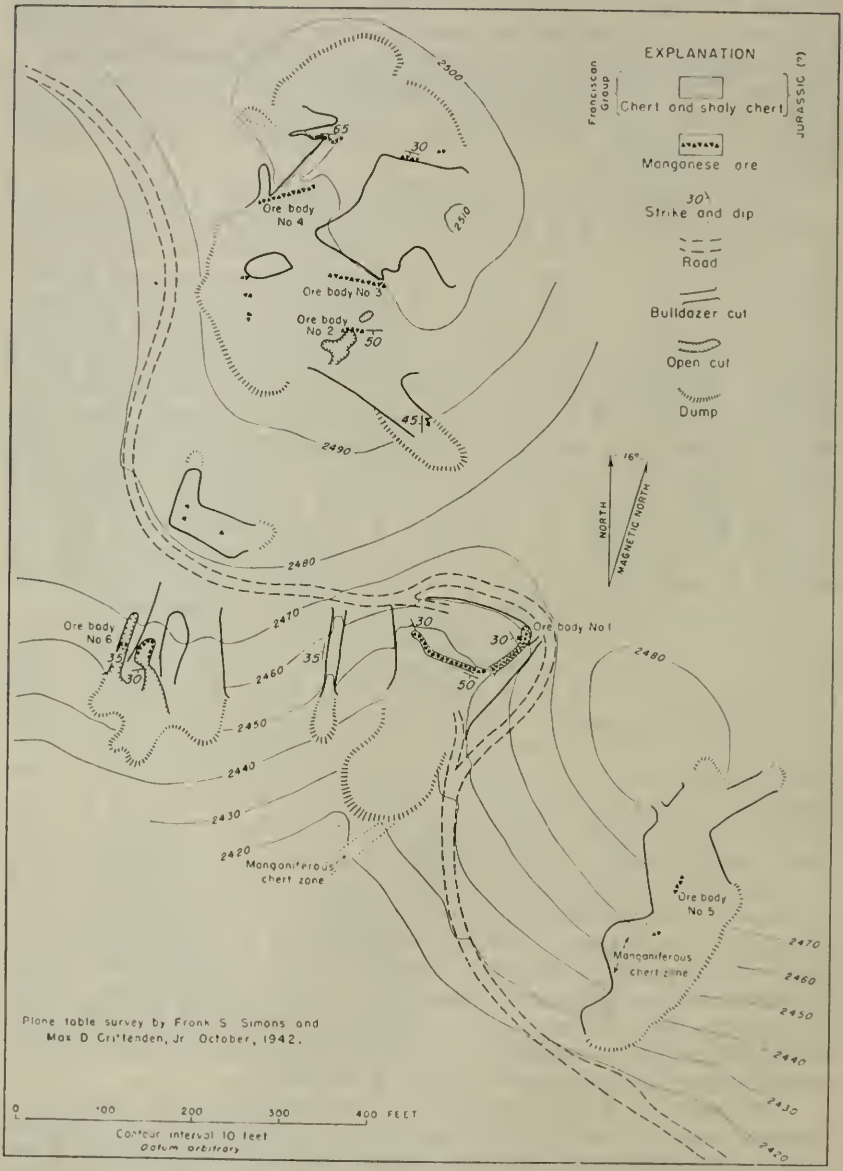
No. 37. Pine Ridge Mine. (By Frank S. Simons and Max D. Crittenden, Jr., October 24, 1942.) The Pine Ridge mine is in sec. 31, T. 8 S., R. 4 E., on the McDermott Ranch, 12 miles northeast of Morgan

Hill. It is held under a mineral lease by Alfred Jackson of Morgan Hill. The road to the mine is in very good condition. The first 4 miles after leaving Highway U. S. 101 are paved; the next 4.4 miles are a gravel surfaced dirt road; and the last 3.6 miles are a good dirt road. The mine is located on the crest of a low knob on Pine Ridge. Outcrops are few. Exploration is being carried on by removing the overburden with a bulldozer. There are a number of separate ore bodies shown in figure 7, which will be described separately. The relations of the various ore bodies are not clear, as the bulldozing has scattered ore and country rock over a wide area.

All the mining is now being done at ore body No. 1, where a bed of manganese oxide ore 3 to 4 feet thick is exposed for a distance of 175 feet. Outcrops are discontinuous but the ore bed seems to follow an arc striking N. 60° W. at the west end, and N. 10° E. at the east end. According to the operator of the mine, the ore body at the original ground surface was nearly parallel to the surface of the hill, but at the depth now exposed dips more steeply than the slope of the hill. Some ore is scattered throughout the area enclosed by the arc of the ore bed, but the rocks are so mixed it is difficult to determine much about them. Both walls of the ore body are brown thin-bedded shaly chert. The ore forms a heavy stockwork with cores of spongy red clay apparently representing leached chert. The ore mineral is principally a blue-black oxide with a brownish black streak, and usually 4 to 5 in hardness. Some soft ore is present. The average ore here contains about 35 percent manganese, and can be easily sorted to 40 or even 45 percent manganese. Ten tons of ore are on the dump, containing 40 to 45 percent manganese.

Ore body No. 2, situated 400 feet northwest of the east end of ore body No. 1, reveals a bed of manganese oxide ore which strikes west. The wall rocks are red chert and buff shaly chert, but the walls were not exposed at any place, so the thickness of the ore bed is not known. At the east end of the exposure the ore is siliceous, and contains numerous pockets of high-grade ore. Seventy feet from the east end, 6 feet of ore is exposed. The ore consists of a peculiar wormy stockwork in varicolored massive chert. The "worm holes" are cores of leached chert, often roughly tubular with diameters of a quarter to a half inch. The ore mineral is a bluish-black oxide, varying in hardness from 3 to 6, but usually 3 or 4. The streak is dark brownish black, and the mineral is apparently amorphous. This ore averages 30 to 35 percent manganese, but breaks well and can be easily sorted to 40 percent manganese. About 35 tons averaging 30 percent manganese are piled on the dump. The ore at the west end is siliceous and is difficult to sort to 35 percent. Fifty tons of siliceous ore, averaging 15 to 20 percent manganese, are piled on small dumps. The bed here is at least 8 feet thick.

Ore body No. 3 is 60 feet north of the east end of ore body No. 2. It contains an ore bed which strikes N. 75° W. for 100 feet in a series of disconnected outcrops. The bed is nowhere exposed entirely. It is 2 feet thick at the west end and dips steeply south. The footwall is thin-bedded red chert and the hanging wall is thin-bedded buff and red shaly chert. The ore is crudely laminated and consists of layers of hard, blue-black oxide (psilomelane?) up to 1 inch thick alternating with thin layers of chert and shale. Eight tons of ore averaging 40 percent manganese are piled nearby. The average grade is 35 to 40 percent manganese, and little


EXPLANATION
Franciscan Group
Chert and shaly chert
JURASSIC (?)
Manganese ore
30
Strike and dip
Road
Bulldozer cut
Open cut
Dump
16°
NORTH
MAGNETIC NORTH
2500
2510
2490
2480
2470
2460
2450
2440
2430
2420
65
30
50
45
35
Ore body No 4
Ore body No 3
Ore body No 2
Ore body No 1
Ore body No 6
Ore body No 5
Manganiferous chert zone
Manganiferous chert zone
0
100
200
300
400 FEET
Contour interval 10 feet
Datum arbitrary

Plane table survey by Frank S. Simons and Max D Crittenden, Jr. October, 1942.

FIGURE 7. Geologic and topographic map of the Pine Ridge mine, Santa Clara County, California.

sorting is needed to raise the ore to this grade. One hundred feet west of the west end of ore body No. 3, several large boulders of high-grade oxide ore have been uncovered by the bulldozer. These boulders seem to represent the continuation of ore body No. 3.

Ore body No. 4 is 100 feet north of the west end of ore body No. 3. It consists of a bed of "wormy" ore 100 feet in length, striking N. 75° E., and dipping 50° S. The ore bed is 3 feet thick at the only place where it is exposed. The ore averages 25 to 30 percent manganese, but can easily be sorted to 35 percent and probably to 40 percent. Five tons of sorted ore are on the dump.

Ore body No. 5 is 350 feet south of ore body No. 1. It consists of a more or less continuous bed of oxide ore striking N. 30° E. The ore is on the southeast side of a prominent chert bed. The thickness of the ore bed is not known. Most of the ore is siliceous and contains 20 to 25 percent manganese, but numerous blocks of ore containing 30 to 45 percent manganese are scattered about the cut. Five tons of ore averaging 35 percent manganese are piled near the cut.

At the west end of ore body No. 5 is a pile of 5 tons of ore collected from the surface of the ground during World War I. The ore consists of small fragments of chert cemented by manganese oxides. A little botryoidal psilomelane is present, which probably represents a surface concentration of oxides leached from the underlying rock. The ore averages 35 percent but some is 45 percent manganese.

Ore body No. 6 is 300 feet west of ore body No. 1. It consists of a bed 6 feet thick in shaly chert striking east and dipping 35° S. The ore is siliceous manganese oxide. It is exposed for 25 feet along the strike in two open cuts.

A manganese zone is exposed 250 feet S. 30° W., from ore body No. 1. It is associated with fine-grained sandstone and shale striking N. 45° E. These rocks overlie a series of thin-bedded and massive white and brown chert beds. Locally the shale contains as much as 40 percent manganese. The best ore appears to be concentrated in a shaly material similar to that commonly forming partings in chert. The ore is a soft oxide best described as wad. It evidently is the result of concentration of manganese oxide by surface waters, as the best ore appears at or near the surface. Several springs are nearby, one of which is uphill from the deposit. Very little development has been done and the tonnage to be expected is small. The average grade of this wad-like ore is about 15 percent manganese. Only a small amount of the ore at this locality contains as much as 30 percent manganese.

This deposit is promising. It contains several ore beds, some of which are fairly thick. The ore is of moderate or good grade and much of it can be sorted to good grade. Past production is reported as 101 tons in 1941 and 325 tons in 1942. The grade of the ore that has been mined averaged 38 percent.

One mile west of the main Pine Ridge mine, a series of open cuts exposes manganese oxide ore. The easternmost cut reveals 2 feet of black oxide ore dipping vertically and striking west. The walls are thin-bedded shaly chert. The ore is soft, has a black streak and probably contains considerable manganese dioxide. The bed is exposed for 6 feet along the strike, the western extension being buried by bulldozing. This ore contains 35 to 40 percent manganese, but the amount in sight is small. About 100 yards to the northwest are two open cuts along a massive chert bed

20 feet thick. The chert strikes N. 55° W., and dips 65° SW. One car of high-grade oxide ore has been shipped from the cut on the southwest side of the massive chert, but the ore lens has pinched out in the face of the cut and very little ore is exposed in the floor. Five tons of siliceous ore containing 10 to 15 percent manganese are on the dump. A small amount of ore has been removed from the northeast side of the massive chert body.

Another 125 feet along the strike to the northwest, a thin bed of oxide ore is exposed in an open cut for a distance of 50 feet. The hanging wall consists of 4 feet of massive white and green chert overlain by thin-bedded buff chert; the footwall is massive white chert. The ore bed strikes N. 45° W., and dips 50° SW. The bed was 12 to 18 inches thick, and has been nearly completely mined out. The ore holds tightly to the footwall and is difficult to mine. About 25 tons were removed, the ore being blue-black oxide containing approximately 45 percent manganese. The ore is vuggy; many vugs contain quartz crystals coated with shiny manganese oxide. Some 75 feet northwest along the strike and across a small canyon, 15 tons of ore have been removed from a pocket. The rocks strike N. 25° W., and dip 60° SW. The hanging wall is thin-bedded shaly buff chert, the footwall massive brown and white chert. The southeast end of the ore lens is faulted against brown sandstone. Very little ore remains in sight in the cut. The ore contains about 35 percent manganese.

These cuts are all along the same general line, and the ore probably occurs at essentially the same horizon, but the amount of manganese ore at any place is small. The deposit is not now being worked, as there is little ore remaining in any of the cuts.

No. 38. Pulse Prospect. (By Frank S. Simons, October 6, 1942.) The Pulse prospect is in the SW¼ sec. 26, T. 5 S., R. 4 E., 2 miles by road from the Arroyo Mocho road and 25 miles southeast of Livermore. It is owned by Jack Pulse of Livermore, and was operated by him for a short time during 1918. A partly caved shaft and road cut show white chert and decomposed buff shaly chert striking N. 30° W., and dipping 50° SW. The chert encloses a body of siliceous manganese oxide ore 2 feet thick at the only place where any ore remains. The ore consists of slightly oxidized pinkish chert containing small pockets of good-grade manganese oxide. The ore is partly exposed along the strike for 35 feet. It apparently lenses out at the north end and is covered by overburden at the south end. The ore now exposed does not contain over 25 percent manganese, and practically none is in sight. According to Mr. Pulse, the shaft was formerly 25 feet deep, and showed a bed of ore 15 feet thick. Some ore, averaging 48 percent manganese, is said to have been shipped, but no ore of this grade is in sight now. The amount of ore remaining at depth is not known.

Six hundred feet east of the shaft there is an open cut 60 feet long in thin-bedded brown shaly chert, which carries thin films of manganese oxide. The chert strikes north and dips 25° E. One bed of massive chert contains about 15 percent manganese, but the amount of ore of this grade is small.

No. 39. Queen Bee No. 1 (Alma) Claim. (By Frank S. Simons and Parker D. Trask, December 1942.) The Queen Bee No. 1 claim is on the west end of the ridge between Jones and Beauregarde Creeks in the SW¼ sec. 29, T. 6 S., R. 5 E. (pl. 11, deposit 11). It was located by Calvin

McMillian on February 27, 1941. It is leased to the Barker Corporation. The production in 1942, up to November 15, was 45 tons. The ore was delivered to the General Dry Battery plant at Patterson. An adit 10 feet long, two open cuts, and two trenches have been opened. The manganese consists mainly of stockwork in white chert, but some ore is massive. The ore bed strikes northwest and dips 65° SW. to vertical. It is 100 feet long and has a maximum width of 6 feet. It widens gradually from a feather edge at the southeast end to 6 feet at the northwest end and then within a distance of 8 feet thins out abruptly. The walls converge downward, and not much ore can be expected at depth. The grade decreases gradually toward the southeast. In the adit at the north end of the ore body the manganese content is about 30 percent, whereas at the southeast end it is approximately 15 percent.

No. 40. San Jose Deposit (Penitencia Creek). (Condensed from original description in Rogers, A. F., An interesting occurrence of manganese minerals near San Jose, California: Am. Jour. Sci., 4th ser., vol. 48, p. 443, 1919.) A huge boulder of manganese ore formerly was situated in Alum Rock Park along Penitencia Creek in sec. 27, T. 6 S., R. 2 E., 5 miles east of San Jose. The entire boulder was broken up during 1918 and yielded 329 tons of ore. No ore now remains. The shipments ranged from 43.2 to 63.5 percent manganese, and contained about 3 percent silica. The minerals according to Rogers are pyrochroite ($Mn(OH)_2$), tephroite (Mn_2O_4), hausmannite (Mn_3O_4), ganophyllite ($7MnO.Al_2O_3.8SiO_2.6H_2O$), rhodochrosite, psilomelane, and barite.

No. 41. Triple Jump Claim. (By Frank S. Simons and Parker D. Trask, December 1942.) The Triple Jump claim is on the north side of Beauregarde Creek 1,000 feet west of the location monument of the Black Eagle claim (Santa Clara 8), in SW¼ sec. 28, T. 6 S., R. 5 E. (pl. 11, deposit 9). It was located by Walter J. Schroeder on September 9, 1940. The ore is siliceous manganese oxide, 2 feet wide, in white chert adjacent to a greenstone body 30 feet thick. The grade is of the order of 10 percent manganese. An area 300 feet long and 100 feet wide has been scraped by a bulldozer, and in addition, four cuts and trenches have been made. Ore is exposed in two places. At the northwest end of the open cut, a series of blocks of siliceous manganese oxide, 2 to 5 feet wide, are exposed over a distance of 40 feet. The trend of the blocks is north 30° W., and the dip is 20° SW. These blocks are associated with greenstone and are cut by many small quartz veins. Some of the adjacent shale has been chloritized. The relation of the greenstone to the manganese is obscure, but the chert in which the manganese is found has been altered hydrothermally. The grade of the ore varies; the average is 25 percent manganese.

Another body of ore, 10 feet long and 4 feet wide, is exposed at the south end of the open cut. The associated rocks are greenstone and altered shale, but the exposures are too poor to indicate the relationship. The grade of the ore here is about 40 percent manganese.

No. 42. Turner Deposit (Black Beauty, Summit). (From files of U. S. Geological Survey, 1917.) The Turner, Black Beauty, or Summit deposit is 27 miles southeast of Livermore in the NE¼ sec. 26, T. 5 S., R. 4 E. The owners are Robert and George C. Turner. A considerable tonnage of siliceous ore is said to be present. Production of 50 tons is reported for 1917.

No. 43. Wallace Ranch. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 79, 1918.) On the Wallace Ranch in sec. 8, T. 6 S., R. 2 E., 6.5 miles by road east of Milpitas, is a small outcrop of high-grade manganese ore. Mrs. Grace P. Wallace of San Jose, is the owner. This deposit lies southeast of the Mateos Ranch prospect (Santa Clara 26), and is evidently a continuation of the same ore body. The chert here crops out prominently in bold ledges over large areas, but for the most part is free from manganese stains. The ore is exposed for a width of 12 inches in a small cut, about 100 feet above the old tunnel on the Mateos ranch. Ore taken from this deposit is reported to have assayed 50.8 percent manganese.

No. 44. Winegar Mine. (By Frank S. Simons, October 7, 1942.) The Winegar mine is in sec. 19, T. 5 S., R. 4 E., 5.1 miles by road from the Arroyo Mocho road and 27 miles from Livermore. It is on land owned by the K. D. Winship Estate, and is leased by Phil Winegar of Vernalis. The ore is found in two beds of siliceous manganese oxide separated along the strike by 80 feet of barren chert. The upper ore bed is exposed in an open cut 70 feet long, and its average thickness is 4.5 feet. The strike is N. 45° W., and the dip is 60° SW. The bed lenses out abruptly 10 feet from the northwest end of the cut, but can be traced southeast of the cut for 150 feet. At its southeast end it is 2.5 feet thick, strikes N. 60° W., and dips 60° NE. Thirty feet below the cut a tunnel 70 feet long has been driven along the strike. The ore body pinches out abruptly almost directly below the point at which it terminates in the cut above. The ore in the tunnel averages 4 feet in thickness. The strike is N. 30° W., and the dip 60° SW. The ore bed is remarkably uniform in thickness.

The ore at the surface is being carefully hand sorted, and is somewhat higher grade than the ore in the tunnel, where surface waters have not been able to leach the silica so thoroughly. The average grade of the ore at the surface is 20 percent manganese, and in the tunnel, 15 percent manganese. The ore is sorted so as to yield more than 35 percent manganese.

Eighty feet northwest of the tunnel portal, a second open cut exposes a bed of siliceous manganese oxide ore 60 feet long and ranging in thickness from 3 to 6 feet. The ore bed is enclosed in shaly chert striking N. 30° W., and dipping steeply northeast. The face of the cut is 25 feet high. The ore is of the same character as that in the upper cut and tunnel, averaging 15 to 20 percent manganese. The ore bed lenses out to the northwest and appears to be faulted off at the southeast end.

Thirty-five tons of sorted ore are on the stock pile, averaging about 35 percent manganese. Total production to November 15, 1942, was 299 tons, averaging 35 to 40 percent manganese. This ore has been sold to the General Dry Battery stock pile at Patterson, and shipping costs have ranged between $4.50 and $5.00 per ton.

No. 45. Winship Leases (Aitken-Wolfe). (By Frank S. Simons, June 10, 1942.) A. C. Aitken and F. L. Wolfe of San Francisco have leased two manganese prospects in sec. 27, T. 5 S., R. 4 E., on land of the K. D. Winship Estate. This prospect is 25 miles by road from Livermore, and was operated by Holbrook and McGuirre during the last war. The predominant rock of the area is massive leached white chert, which seems to strike north. Practically no rock can be seen in place, and attitudes are uncertain. Enclosed in this chert is a poorly defined bed of oxide ore of unknown thickness, which can be traced for 40 feet on the surface. The ore grades into massive chert to the north, and the south end is buried. Most of the ore is very low in grade, containing about 15 percent manganese and much silica, but some ore contains 35 percent manganese. The relations of ore to country rock in two open cuts are not clear, as the cuts are partly caved. A tunnel that was driven in 1918 from a point 150 feet west of the ore bed is said to have extended beyond the projected position of the ore bed at a depth of 30 feet below it, without encountering ore. The ore thus does not seem to persist to any great depth, as is also suggested by the irregularity of the surface exposures. The only good ore occurs near the surface or at the surface, where much of the silica has been leached, leaving skeletons of silica and manganese oxides. A few feet below the surface the silica is porous but less leached than at the surface, and at a depth of 10 feet the ore is low in grade and siliceous. The deposit is said to have yielded 125 tons in World War I and has produced 12 tons in World War II.

A second deposit in the SE¼ sec. 27, T. 5 S., R. 4 E., is 24 miles by road southeast of Livermore. The area is very heavily covered with brush and only a few exposures are visible. The predominant rock of the area is thin-bedded red chert, which strikes about east. Three outcrops of siliceous manganese oxide ore have been exposed by shallow cuts. The westernmost outcrop shows 5 feet of siliceous ore in white chert striking N. 60° W., and dipping 25° SW. Fifty feet east an outcrop of similar rock strikes east and dips 60° S., and 60 feet east of this another exposure of chert, with some manganese oxide films, strikes N. 70° W., and dips 45° SW. These outcrops appear to be parts of a more or less continuous bed of siliceous manganese oxide ore. The best ore seen does not contain over 25 percent manganese, and the average grade of all ore is about 15 or 20 percent manganese. Very little development work has been done, so the character of the ore at depth remains unknown, but, by analogy with other deposits of a similar type, it is thought that the ore at depth will be more siliceous and lower in grade than the well oxidized part of the ore bed at the surface. One hundred ten feet below the ore bed a tunnel 210 feet long was driven into the hill to tap the bed at depth. This tunnel exposes a white and green chert interbedded with shale, striking N. 55° W., and dipping 30° to 50° SW. No ore of any kind is exposed in the tunnel, which is considerably longer than should have been necessary to reach the ore bed. Thus, barring considerable faulting, which is not evident in the tunnel, the ore bed can be assumed to lens out before reaching 110 feet in depth.

This prospect is not considered promising, as the grade of the ore is very low. However, a considerable tonnage may be present, if a market for the available grade of ore materializes.

SHASTA COUNTY

No. 1. Arps Prospect. (From files of U. S. Geological Survey, 1918.) A deposit owned by C. L. Wilson of San Francisco is located near Copper City, 5 miles from Heroult, probably in T. 33 N., R. 4 W. It is said to be 1,200 feet in length and 125 feet in thickness. The prospect was not visited but by analogy with deposits in this general area, the grade is likely to be low.

No. 2. Duncan Creek Prospect. (From files of U. S. Geological Survey, 1918.) A deposit located in T. 30 N., R. 8 W., west of Ono on Duncan Creek, is said to be owned by the American Manganese Mining and Smelting Company. Other details are lacking.

No. 3. Exposed Treasure Barite Prospect. (From files of U. S. Geological Survey, 1918.) The Exposed Treasure Barite prospect, located in the southwest part of T. 36 N., R. 1 W., is said to contain manganese.

No. 4. Goat Camp Claim. (By Parker D. Trask, August 1942.) The Goat Camp claim is situated at an altitude of about 5,000 feet near the west boundary of Shasta County in the SW¼ sec. 36, T. 29 N., R. 11 W. The deposit is located along the side of a forest road, 60 miles from Red Bluff, the nearest rail point. Two claims trending north and south were taken out by G. E. Riemert and W. O. Friend of Hayfork. Development work consists of two shallow pits about 5 feet in diameter. The ore occurs in a small chert body enclosed in greenstone. The ore minerals in order of quantity present, are rhodonite, bementite, and rhodochrosite. The size of the ore body is about 4 by 4 feet, and there is little reason to believe it is more extensive, as the chert in which it lies is completely surrounded by greenstone. The grade of the ore is estimated to be about 30 percent manganese, but the total reserves are probably less than 20 tons.

No. 5. Nicol Deposit. (By Parker D. Trask, August 1942.) The Nicol deposit is in the SW¼ sec. 22, T. 29 N., R. 9 W., 2 miles south of Platina and 45 miles from Red Bluff, the nearest rail station. It is situated on the side of a steep mountain about 1 mile by trail from the nearest road. The deposit is reported to be on fee land owned by Mrs. E. M. Nicol. One cut 8 feet deep has been opened, presumably in World War I. No ore has been shipped. The deposit is in massive chert which strikes N. 85° E., and dips nearly vertically. The ore body has a maximum width of 5 feet and can be traced for 50 feet. About 100 yards across the strike to the north the chert is succeeded by greenstone. The ore consists of low-grade oxide estimated to contain between 10 and 15 percent manganese. By analogy with rocks in the same geologic setting, the primary ore is manganiferous chert and perhaps rhodonite.

No. 6. Nigger Hill Claims. (By Ivan F. Wilson, July 25, 1942.) The Nigger Hill claims are 11 miles west of Ono. They are reached by driving along the road west of Ono for 7.7 miles, then turning north along a branch road for 3.2 miles to the top of a ridge. Some ore has been developed at this point, but the main workings are 1,700 feet to the east along the ridge. The altitude is about 2,800 feet. The nearest shipping point is Redding, 28 miles distant, but the ore is now being hauled to Anderson, 32 miles east. The last 3.2 miles of the road are steep, but the road is in good condition. The property comprises four claims, occupying 480 acres. It embraces the W½E½, and the W½ sec. 14, T. 30 N., R. 8 W. The claims are owned by Glen Murphy of Ono, and are being operated by Kuppinger & Pinkham of Lakeport. When the main workings were visited, a cut across the ore bed had just been opened to depth of 1 foot to 2 feet. A quarter of a mile down the slope to the northeast is an old shaft 10 feet long by 3 feet wide, 20 feet deep, which exposes the manganese-bearing rock.

The manganese ore occurs in beds of lenses of fine-grained quartzite or quartz schist, which seems to be recrystallized chert. The chert is enclosed in a quartz-rich medium-grained quartz-muscovite-biotite schist which consists of quartzose layers separated by finer layers of mica. This schist is in an area indicated on the State Geologic map [1] as "Pre-Cambrian metamorphics." Both the metachert and enclosing schist are cut by quartz veins 3 to 4 inches thick.

At the main workings in the eastern part of the property, near the crest of the ridge, the manganiferous metachert is exposed intermittently for 330 feet. The thickness of the ore ranges between 4 and 8 feet. The bed appears to be offset by faults in places. One or more smaller manganiferous beds may lie parallel to the main bed. Another exposure of manganiferous metachert is about 250 feet down the slope to the east. Other exposures occur at intervals up to a quarter of a mile southeast, where the shaft exposes a manganiferous metachert cut by quartz veins. Little manganese, however, is present at this place.

Where the road crosses the ridge, 1,700 feet west of the place mentioned as the "main workings," manganiferous rocks are exposed at intervals within an area about 100 feet long and 30 feet wide. Two or more beds probably are present here, unless one has been repeated by faulting. At one place a block of ore about 6 feet thick, is exposed, and another bed about 30 feet north is exposed for a width of 2 or 3 feet. The ore beds and enclosing schist at the main workings strike N. 45°-70° W., and dip 40° to 50° NE. At the shaft to the east the strike is N. 60° W., and the dip close to vertical.

The manganese ore consists of psilomelane and pyrolusite, containing red iron oxide stains and larger or smaller patches of the quartzose material of the metachert. Some of the ore appears to be rather high grade, and should run 45 percent manganese. Other ore is much lower in grade, however, and the one cut that was completed across the ore bed at the time of the visit revealed material which was mostly quartz, with manganese oxides scattered through it. The bed here probably does not average more than 10 percent manganese.

At the outcrop about midway between the main workings and the shaft is partly oxidized pink rhodonite, which is probably the main primary mineral of the Nigger Hill deposit.

No. 7. Shasta Copper Mine (Pit River Consolidated). (By R. R. Morse, July 29, 1918.) Manganese ore has been mined on claims belonging to the Shasta Copper Company, situated on the south side of the Pit River directly opposite the Noble Electric Steel plant at Heroult. This plant is served by the privately owned Sacramento Valley and Eastern Railroad, connecting the mining district of Bully Hill with the main line of the Southern Pacific at Pit Station, 6 miles west of Heroult. The Shasta Copper Company's property consists of 38 mining claims comprising the S$\frac{1}{2}$ sec. 36, T. 34 N., R. 4 W., and the W$\frac{1}{2}$NE$\frac{1}{4}$ sec. 1, T. 33 N., R. 4 W. The manganese ore shipped to the smelter was mined from workings near the center of the N$\frac{1}{2}$SE$\frac{1}{4}$ sec. 36. Outcrops of similar ore occur at other localities on the claims, notably at a point near the center of the W$\frac{1}{2}$ sec. 1.

The claims are said to have been located for the purpose of developing supposed copper deposits underlying the prominent gossan of this region. Shallow cuts disclosed the presence of considerable manganese ore. Analyses of the gossan indicated that manganese occurred quite generally in the surface rock of the claims. In 1916 the claims were leased to the Noble Electric Steel Company. In 1916 and 1917 this company mined and removed about 1,000 tons of ore, using it in their nearby plant for the production of silico-manganese alloy. The average manganese content of this lot of ore is reported to have been about 27 percent.

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[1] Geologic map of California, scale 1:500,000, California Div. Mines, 1938.

In the fall of 1917 operations at the mine ceased. The smelter officials are said to have claimed that the ore could not successfully be used in the process because of electrode troubles produced by the ore. However, the fact remains that silico-manganese was successfully manufactured and disposed of from the 1,000-ton lot removed from the workings. The claims have not been operated since abandonment by the steel company. Assessment work by the owners has consisted in digging many shallow cuts exposing low-grade manganese ore at several points on the property.

Several short tunnels were driven into the soft ore and country rock at the locality of the most promising exposures. These underground workings aggregate about 200 feet in length and are caved at several points. The ore removed from these workings and from an open cut above was wheeled in barrows to a 50-foot chute constructed of rough timbers, available nearby. The chute conveyed the ore to a log bunker of 30- or 40-ton capacity. From the bunker the ore was transported to bins on the south bank of the Pit River by mine cars over about 0.6 mile of track. From this point it was carried by aerial tram across the river to bins at the smelter.

The manganese ore occurs within a mass of highly decomposed siliceous porphyry, exposed beneath heavy overburden by many cuts in a narrow area extending from near the center of sec. 36, T. 34 N., R. 4 W., southward to a point 0.3 mile west of the center of sec. 1 of the adjoining township. At many points in this area a hard gossan occurs at the surface, similar to the prominent ''iron caps'' commonly found in the vicinity of the iron-copper deposits. Manganese is also present in this hard gossan.

The manganese-bearing porphyry occurs in the northwest corner of a broad, roughly rectangular-shaped area of shale and associated rocks of the Pit formation of Middle and Upper Triassic age, occupying the greater part of the adjacent township on the southeast, as mapped in the Redding folio of the U. S. Geological Survey.[2] The prevailing strike in the vicinity is north and the dip in general is east though local variations are common. Progressively older belts of rocks crop out to the west.

West of the manganese-bearing porphyry in places resting against it in abrupt contact, are outcrops of a dense bright red jasper. This rock is cut by many complexly intersecting veinlets of quartz. It breaks into irregular sharp fragments in which a flinty texture and subconchoidal fracture are characteristic. Its color is due to a rather uniformly distributed fine red oxide of iron. Here and there slight stains of manganese oxide occur. Small crystals of pyrite and chalcopyrite occur scattered through the rock, as well as in the quartz veinlets. Secondary changes have developed a vitreous appearance in much of the rock, suggesting an early stage of recrystallization. This feature effectively masks any determinative features that might have previously existed.

The jasper is strikingly similar to the red chert of the Franciscan group so commonly associated with manganese deposits in the Coast Ranges. The locality is, however, not far from the isolated area in sec. 36 mapped in the Redding folio [3] as ''Bully Hill rhyolite''. The map of the folio does not show the area of ore-bearing porphyry and the adjacent outcrops of jasper here discussed.

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[2] U. S. Geol. Survey Geol. Atlas, Redding folio (no. 138) 1906.
[3] Op. cit.

The material mined as ore consists of an intimate mixture of black manganese oxides with kaolin, iron oxides, quartz, opal, and chalcedony, the decomposition products of the porphyry. It is soft and easily broken. Because of this character, and the close association of the ore minerals with the friable gangue, it is impossible in mining operations to improve the ore by selective sorting at the faces. On a small scale the distribution of manganese is irregular, but on a scale compatible with economic mining practice the ore is of a uniformly low grade.

The lot of 1,000 tons of this ore, which was used at the smelter in the manufacture of alloy, is said to have averaged about 27 percent manganese. The impurities of this ore are shown in the following analysis: iron, 6.72 percent; phorphorus, 0.18 percent; silica, 34.04 percent; manganese, 19.77 percent; and gold, $1.65 per ton.

The following sample was taken by selection of the material most heavily stained by oxides, chiefly from the black outer shells surrounding barren cores of ''waste.'' In places it carried thin crusts of alternating hard and soft oxide films, believed to represent psilomelane and pyrolusite: manganese, 28.1 percent; ferric oxide, 6.2 percent; insoluble, 33.3 percent; available oxygen, 6.96 percent.

The hard gossan occurring at several points on the claims has not been considered seriously as ore. Several assays have, however, indicated that it commonly carries manganese. The amount of manganese in these samples varied from 10 to 15 percent. In places it is said to have assayed $1.25 or less per ton in gold, and several ounces of silver.

This ''iron cap'' is resistant to weathering. Its color varies from deep red to purple and maroon. It generally has a porous, leached appearance, and cavities are lined with oxides of iron, copper, manganese, and opaline silica. Very fine crystals of iron and copper sulphides are sprinkled throughout. Dull coatings of a powdery black manganese oxide are commonly the latest linings of the cavities. Thin films of a harder steel blue oxide showing a shining or metallic luster sometimes alternate with the duller powder.

At the main workings the ore has been exposed by stripping for a distance of about 150 feet. It is here between 55 and 60 feet in width, limited on the west by the red jasper in sharp contact, and on the east by a gulch beyond which is the wide area of shale in the Pit formation. The longer dimension parallels the schistosity or shear planes which everywhere traverse the ore-bearing porphyry. In this direction the ore exposures are limited only by overburden. Cuts here show streaks of ore clearly related to particularly crushed or sheared portions of the porphyry, outward from which the dark oxides gradually fade over a distance of several feet. In very few places is there an abrupt change from ore to barren bleached porphyry.

In the lower-grade material the manganese oxides are present as stains and thin films along the multitude of shear planes and cross fractures cutting the porphyry. As the manganese content becomes higher, the dark oxide stains become broader; films of pure oxides on shear planes are bordered by broad outward-fading zones of soft porphyry stained with the oxides. Where shearing is most pronounced the outcrops are nearly uniformly stained and this ore may be thinly laminated. Very commonly this lamination curves around harder parts of the rock so that in caving the ore, numerous oval or elongated pieces drop out. These oval pieces are invariably found to possess heavily stained outer zones of varying thicknesses, surrounding circular cores of spongy, bleached, or iron-stained, kaolinized porphyry, altered almost beyond recognition. In fact the porphyry is everywhere so altered that only rarely can satisfactory evidence be found of its initial character.

The persistent tendency toward a concentric arrangement of these manganese-stained shells is noteworthy. The outline of the inner barren cores is always circular and the boundary between core and shell is remarkably sharp. The material of the ore is generally soft crumbling clay, more or less stained with brown oxides of iron. Small angular grains of clear quartz may be noted by rubbing the clay between the fingers. Here and there the cores still retain evidence of the original porphyritic nature of the rock, where clear anhedral quartz grains and lath-shaped and square patches of pure white kaolin occur scattered rather abundantly through a ground mass consisting of structureless siliceous clay, spotted with small patches of brown iron oxide. The porphyritic texture is also preserved in the outer shells where phenocrysts of quartz are preserved in their original position, but here these constitute the only original component of the rock not completely masked by alteration or by the heavy staining of the manganese.

From the evidence thus obtained it is apparent that the rock enclosing the ore deposit was originally an acidic porphyry of medium to coarse texture containing rather abundant phenocrysts of quartz and feldspars in a groundmass carrying numerous smaller ferromagnesian minerals, but the texture of this groundmass is not now determinable. It is also apparent that kaolinization and shearing of the porphyry preceded the introduction of the manganese oxides, in part if not wholly. Later alterations have resulted in the deposition of manganese oxides and opal in cavities in the original ore. Botryoidal crusts of thin alternating films of opal, dull-black powdery manganese oxide, and harder steel blue shining oxide, line the cavities at many places.

By analogy with the geology of the region it seems probable that this rock is an alteration product of an intrusive similar to the alaskite porphyry bodies associated with the copper deposits of the nearby Bully Hill, Iron Mountain, and Little Backbone districts, described by Graton.[4] In the earlier work similar rocks in the Bully Hill district were termed ''Bully Hill rhyolite.'' The occurrence of the manganese ore does not, however, appear to parallel that of the copper ore described by Graton as replacing the alaskite.

The presence of isolated quartz phenocrysts in the manganese ore has been described above. There is, however, no clear evidence of replacement in this ore. The ore oxides appear to be present chiefly as heavy stains in the spongy mass of decomposed porphyry and linings of cavities developed after the entrance of the ore. As pointed out above, the entrance of the ore solutions was apparently made possible, as in the copper deposits, by extensive shearing of the porphyry. It appears probable that, with respect to manganese, the porphyry had become highly decomposed before the ore solutions were introduced.

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[4] Graton, L. C., The occurrence of copper in Shasta County, California: U. S. Geol. Survey Bull. 430, p. 81, 1910.

Ore of the character exposed in the main workings of the claims is exposed for 150 feet, in widths of 55 to 60 feet. The longer dimension is limited only by overburden. Assuming these dimensions as limits, and that the ore continues in depth to the level of the gulch adjacent on the east, there should be about 25,000 tons thus available. This material could not be expected to run higher than 15 to 20 percent manganese.

No. 8. Victor Mine. (By R. R. Morse, August 6, 1918.) Manganese ore has been reported from the property of the Victor Mining Company, now operating the old Midas mine at Harrison Gulch, Shasta County, in T. 29 N., R. 10 W. It was discovered on the south slopes of Chauncelulu Mountain, at a point about 7 miles from the Midas mine. At this locality manganese oxides occur as irregular soft bunches and fracture fillings in a hard bluish quartzose rock believed to be metamorphosed chert. This rock is associated with quartz-mica schist, which is included in a broad area of serpentine and acidic intrusives, chief of which is quartz porphyry. No ore of commercial value was seen at the time of the visit.

SISKIYOU COUNTY

No. 1. Allen Mine. (By Frank S. Simons, August 1942.) This mine may be the same as Clear Creek, Barham, and Collier prospects. The Allen mine is in sec. 8, T. 44 N., R. 8 W., on the northeast side of Clear Creek, a tributary of McAdams Creek. It was located by Leslie Allen and Edward Snyder on July 21, 1941, and was subsequently purchased by Lewis and Reynolds. The prospect is 7 miles by road north of Fort Jones. James Allen worked the property in 1918 and shipped a small amount of high-grade ore. During the last few months a road has been built to the property and a small amount of development has been done with a bulldozer.

An open cut 100 feet long exposes 20 feet of siliceous manganese oxide ore striking northeast and dipping 60° SE. About 5 feet of quartz-rhodonite ore is exposed along the hanging wall. Most of the ore consists of skeletons of manganese oxide surrounding cores of leached silica. The wall rocks are interbedded quartzite and quartz-mica schist.

No ore crops out northeast of this cut. Fifty feet southwest of this cut another smaller cut reveals 10 feet of similar ore. The cut is caved, and the thickness of ore and the geologic relationships are not clear. About 20 tons of siliceous ore has been mined from this cut. This ore appears to be on the strike of the ore exposed in the cut to the northeast.

Fifty feet west of the main cut a thin stringer of ore has been mined. A few tons of ore are piled on the stock pile, but no ore is exposed in the cut. Two hundred feet east of the main ore bed, siliceous manganese oxide ore crops out for 100 feet along the strike. No exploration work has been done here. The grade of the ore probably decreases with depth. The prospect is not regarded as promising because of the siliceous nature of the ore and the probability that the primary ore is largely rhodonite.

According to Mr. Lewis, Vernon Farnum of Oakland, drilled a series of vertical holes along the projected strike of the main ore bed northeast of the main cut for half a mile, finding ore containing from 20 to 38 percent manganese in each hole. No other information on these drill holes was available, and their location is not known.

No. 2. Baker Prospect. (By R. R. Morse, August 20, 1918.) A claim locally reputed to include outcrops of high-grade manganese ore is situated near the summit of Rattlesnake Mountain, 12 miles by the Indian Creek road from Fort Jones. This locality is about 32 miles southwest of Yreka, in the southwest corner of T. 45 N., R. 9 W., on what is shown on the Siskiyou Forest Reserve maps as Scott Bar Mountain. The claim was located by Baker Brothers of Fort Jones.

The country rock consists of evenly bedded dense black chert, separated by partings of slaty black shale. The chert is from 30 to 50 feet thick, and dips steeply. East of the chert is an extensive area underlain by weathered quartzite and quartz-mica schist, with scattered bands of dark phyllite. Fine-grained blue to gray limestone occurs in two ledges only a few feet thick, 0.3 mile east of the chert, within the area of quartzite. Thin layers of graphitic mica schist which occur have been mistaken for ore by the claim owners.

The rocks of this locality resemble the series exposed in the Wildwood district (Trinity 81), in the vicinity of the Lucky Bill (Trinity 58) and nearby prospects. If the chert there exposed belongs to the Kennett formation, the chert on Scott Bar Mountain also may belong to this formation.

No. 3. Barham Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 81, 1918.) Dr. W. W. Barham of Yreka reports he has made locations on a body of somewhat siliceous manganese oxides in sec. 9 or 16, T. 44 N., R. 8 W., southwest of Yreka. The claim is near a wagon road, 11 miles from the railroad. The manganese-bearing material is 10 feet wide. The property is undeveloped.

No. 4. Brown Prospect. (By Frank S. Simons, August 2, 1942.) Bert Brown of Cecilville is reported to have a manganese prospect in sec. 30, T. 39 N., R. 10 W., in the first gulch northeast of Shadow Creek, a tributary of the east fork of the south fork of the Salmon River. The prospect is 6 miles by road and half a mile by trail northeast of Cecilville, 22 miles from Sawyers Bar, and 77 miles from Yreka, the nearest railroad point.

The writer examined this gulch for 1 mile above the Salmon River. The only manganese-bearing rock seen was a small amount of quartz sericite schist carrying thin films of manganese oxide. The prospect was not found. Mr. Brown was not in the area at the time of the writer's visit, and none of the people contacted knew where the prospect was.

Many recrystallized white chert fragments were found in the gulch, but no manganese was associated with them. The prospect, to judge from the float found, is probably of little consequence, and the primary ore mineral is likely to be rhodonite.

No. 5. Callahan District. (By Frank S. Simons, August 20, 1942.) Inquiry was made at Callahan, in sec. 20, T. 40 N., R. 8 W., regarding manganese prospects in the vicinity. A few pounds of very siliceous ore were said to have come from an abandoned gold prospect on the crest of Scott Mountain near the road from Callahan to Trinity Center, presumably in sec. 32, T. 40 N., R. 7 W. No ore was in sight when the prospect was abandoned, and it was not visited in this investigation. This deposit is the only occurrence of manganese reported in the district.

No. 6. Chaparral Hill Prospect. (By Frank S. Simons, August 1942.) The Chaparral Hill deposit is in sec. 9, T. 43 N., R. 9 W., on the top of Chaparral Hill near the northwest end. It is 2 miles by road and 1.5 miles by tractor road southwest of Fort Jones. The property was leased by the West Coast Metals, Ltd., of which the members are Toy L. Young, H. C. Wadell, James C. Rodger, and Charles M. Wolfe. The company is said to have shipped one car of ore which failed to meet government specifications of low-grade B ore (35 percent manganese). The lease has been terminated and the property is idle.

A remnant of a more extensive bed of manganiferous chert overlies quartz-mica schist. The chert is 25 feet thick at the thickest part, and averages 10 feet in thickness. It crops out over an area 40 feet long by 30 feet wide.

The ore is a siliceous oxide material, disseminated in recrystallized chert. The oxide also occurs as films along fractures in the chert. No primary ore was found. A small amount of ore contains 40 percent manganese, but the average grade of the deposit is 20 to 25 percent.

No. 7. Collier Prospect. (By R. R. Morse, August 1918.) The Collier prospect is near the Allen deposit (Siskiyou 1), in sec. 8, T. 44 N., R. 8 W., 16 miles west of Yreka. It is owned by B. K. Collier. The deposit is low in grade, consisting of films of manganese oxide. The average manganese content is less than 10 percent.

No. 8. Crawford Prospect. (By Frank S. Simons, August 11, 1942.) The Crawford prospect is in sec. 28, T. 46 N., R. 12 W., on the west side of Grider Creek about 1,000 feet above the creek. It is 1.5 miles by trail from the China Creek-Marble Mountain road, 8 miles from Seiad Valley, and 51 miles from Yreka, the nearest railroad point. The prospect is idle at present. It was located by Cyrus Crawford of Seiad Valley.

At the edge of a landslide bench on the steep west wall of Grider Creek canyon are numerous large fragments of manganiferous chert. This belt of chert can be traced for half a mile along the strike, which is north. At the south end is a small amount of banded rhodonite-quartz rock, apparently in place. The remainder of the ore is purplish chert, metamorphosed to quartzite. The associated rocks are diorite, gabbro, hornblendite, and serpentine.

An assay of the purple manganiferous chert gave 8 percent manganese. There is perhaps 100 tons of this material in sight, and no more can be predicted as all the rock is in landslides. No development work has been done.

No. 9. Davis Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 81, 1918.) Reeves Davis of Happy Camp has a manganese prospect 8 miles above Happy Camp, and 1 mile east of Indian Creek in T. 17 N., R. 7 E. The ore body is said to be 7 feet thick. No development has been done.

No. 10. Dozier Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 81, 1918.) M. Dozier of Los Angeles owns a deposit in sec. 15, T. 46 N., R. 6 W., 6 miles southwest of Klamathon between Montague and Hornbrook. The deposit is said to be a large body of siliceous manganese oxide containing 30 percent silica and 37 percent manganese. In May 1918 the Noble Electric Steel Company of San Francisco was reported to have an option on this deposit, but no ore was shipped. Siliceous manganese oxides are reported in quantity on the ridge north of Greenview and southeast of Oro Fino, in secs. 20 and 21 (?), T. 43 N., R. 9 W.

No. 11. Etna District. (By Frank S. Simons, August 20, 1942.) Frank Bodecker reports a small completely undeveloped prospect on French Creek in T. 41 N., R. 9 W., near Etna. Specimens of ore seen were composed of well oxidized rhodonite, some of the oxide probably containing 50 percent manganese. Mr. Bodecker said that no outcrops were in the area, all ore being float. The prospect was not visited.

No. 12. Everill Prospects. (By Frank S. Simons, August 12, 1942.) The Everill prospects are in sec. 9, T. 46 N., R. 11 W., near the crest of the divide between Schutts Gulch and Seiad Creek. They are 5 miles by trail from the Klamath River road between Seiad Valley and Hamburg, 45 miles from Yreka, the nearest railroad point. The prospects were located by Charles Everell of Hamburg.

Three prospects are present, but only one merits description. Here siliceous rhodonite crops out over an area 30 feet long and 10 feet wide. These outcrops occur along the outer edge of a small bench on a steep slope leading down to Seiad Creek, and probably are part of a small landslide. The strike is east. The wall rocks, where exposed in a small cut, are slate and quartz-mica schist. Some of the rhodonite is completely oxidized. The best ore consists of 50 percent rhodonite and 50 percent quartz, or about 25 percent manganese at best. Most of the rock contains considerably more than 50 percent quartz. The other two prospects were in rock which contains at least 90 percent chert and decomposed chert. A very small amount of manganese oxide lay along fractures. About 50 tons of material averaging 20 percent manganese was seen in the entire group of prospects.

No. 13. Fort Jones Mine. (By Frank S. Simons, August 19, 1942.) The Fort Jones mine is in sec. 3, T. 43 N., R. 9 W., 0.3 mile by road southeast of Fort Jones, and 18 miles from Yreka, the nearest railroad point. The owners of the property are J. F. Lewis and R. B. Reynolds. An open cut 100 feet long exposes a bed of very siliceous manganese oxide ore, which strikes N. 30° E., and dips 60° SE. The ore bed is faulted off at the north end and appears to lens out at the south end. The maximum thickness exposed is 6 feet, near the north end. The wall rocks are micaceous quartz schist, a small amount of which appears to be glaucophane schist. Near the north end of the ore bed, the rocks are intruded by a dike of deeply weathered basalt 2 feet thick. All the rocks are considerably fractured, and the walls of the dike have been sheared. The ore is siliceous manganese oxide. A network of oxide surrounds cores of silica, some of which are deeply leached. Several carloads of ore were shipped from this mine, but all fell below specifications for low-grade "B" (35 percent manganese). The average grade of the ore is 20 to 25 percent manganese, and the silica content is high.

No. 14. High Light No. 1 Claim. (By Frank S. Simons, August 1942.) The High Light No. 1 claim is in sec. 25, T. 14 N., R. 4 E. It is 2 miles from the nearest road, and 104 miles from the nearest railroad. The owners are Robert Alpheus and Joe Rivers of Orleans. The property is leased to Fred Chapman of Oakland. The prospect is in a large irregular mass of chert altered to quartzite. At several places within the quartzite small areas show thin films of purplish manganese oxide. No ore of commercial grade is in sight, and probably none will be found.

No. 15. Huey Prospect. (By Frank S. Simons, August 13, 1942.) The Huey prospect is in sec. 1, T. 17 N., R. 6 E., near the crest of the divide between Cole Creek and Indian Creek at the head of Deadman Gulch. It is 2 miles by trail from the South Fork of the Indian Creek road, 10 miles from Happy Camp, and 80 miles from Yreka, the nearest railroad point. It was located by Vernon Huey of Happy Camp. Mr. Huey was unable to accompany the writer to the prospect, and although a search was made for the prospect, it was not found. Specimens of ore were seen, however. The material is largely a mixture of rhodonite and quartz, the rhodonite usually composing about half the rock. The ledge is said to crop out for 100 feet along the strike.

No. 16. Kappler Prospect. (From files of U. S. Geological Survey, 1918.) A deposit owned by Charles Kappler is reported from sec. 29, T. 42 N., R. 9 W. No other information is available.

No. 17. Kelley Lake Prospect. (By Frank S. Simons, August 7, 1942.) The writer was informed that a manganese prospect was situated on the trail between Poker Flat and Kelley Lake, half a mile north of the lake. This locality is in the NE¼ sec. 33, T. 18 N., R. 7 E., about 3 miles by trail from Poker Flat, which is 22 miles from Happy Camp, and 97 miles from Yreka, the nearest railroad point. The area was examined by the writer, and no manganese, with the exception of a few films of oxide on brown sandstone, was seen. The locator, a Mr. Kelley, is no longer in the vicinity, and his nearest neighbor did not know where the prospect was. The area is rugged and far from any railroad, and, unless a large quantity of ore was present, the transportation problem would be difficult.

No. 18. Lewis Prospect. (By Parker D. Trask, September 22, 1942.) The Lewis manganese deposit is located at an altitude of about 3,100 feet on the east side of Chaparral Hill, 1.5 miles southeast of the town of Oro Fino in Scott Valley, in sec. 20, T. 43 N., R. 9 W. The deposit lies on a ranch road 1 mile east of the highway from Oro Fino to Fort Jones. The highway is paved to Yreka, the nearest rail point, a distance of 28 miles. The deposit is on land owned by John J. Lewis of Oro Fino. At present it is under option to A. Stanley Bishopric and R. A. Nicol of San Francisco. A pit 10 feet in diameter and 8 feet deep was dug by Mr. Lewis 50 years ago. No work has been done since.

The ore consists of crudely banded oxide in quartzite, and is similar to the ore in another deposit owned by Mr. Lewis 1 mile northeast in the general line of strike. As the primary ore in this other deposit consists of banded rhodochrosite and quartzite, the primary ore at the Lewis prospect presumably is the same. All the ore lying on the dump has been completely oxidized during the 50 years it has lain there, thus suggesting its derivation from rhodochrosite. The host rock is fine-grained quartzite which seemingly has been derived from thin-bedded chert. The strike is northeast and the dip is vertical.

The ore body is lenticular and is 15 feet long. The maximum width is 4 feet. Less than 50 tons of ore averaging 15 percent manganese is estimated to be present. Manganese float is seen here and there for 0.3 mile to the southeast in the projection of the strike, and a few pods similar to the one described may be present, but no large concentration of float was observed that would indicate the location of any such lens.

No. 19. Lighthill Prospect. (By Frank S. Simons, August 10, 1942.) The Lighthill prospect is in sec. 22, T. 45 N., R. 10 W., on the south side of Mill Creek, a tributary of the Scott River. It is owned by

George Lighthill of Scott Bar. The prospect is 1 mile east of Scott Bar, and 42 miles from Yreka, the nearest railroad point. A prominent ledge of quartzite and quartz-mica schist can be traced up the south side of Mill Creek canyon for 300 feet. The schist strikes east and dips 25° S. Near the lower (west) end of the outcrop is an exposure of sheared manganese oxide ore about 6 feet thick and 15 feet long. The ore is a mixture of manganese oxide and quartz, containing less than 10 percent manganese.

No. 20. Manganese Nos. 1, 2, 3, and 4 Claims. (By Frank S. Simons, August 1942.) The Manganese Nos. 1, 2, 3, and 4 claims are in secs. 1 and 12, T. 15 N., R. 7 E., on the west side of Elk Creek along the Elk Creek road. They were located by Pat Crow of Happy Camp on June 3, 1942. The claims are 9 miles by road from Happy Camp and 84 miles from Yreka, the nearest railroad point. No development has been done.

A thick series of massive crystalline chert is exposed from 1,000 feet along the Elk Creek road. The chert forms steep cliffs along the west side of Elk Creek. At the north end of the exposure the chert strikes N. 30° E., and dips 50° SE., overlying thin-bedded shaly chert. At the south end the chert is in intrusive or in fault contact with a fine-grained olivine gabbro. The nature of this contact is not certain, as it is not exposed. The chert is intensely contorted. Bands of red and purple chert alternate with thin bands of a peculiar dark material which may be hematite or some manganiferous mineral. It occurs in bands up to 6 inches in thickness. Films of manganese oxide coat the chert, but no ore was seen.

It is difficult to estimate the amount of chert present. The chert is exposed for 1,000 feet along the strike, with a probable average thickness of 300 feet and an extent down the dip of perhaps 500 feet. These figures give about 15,000,000 tons of rock containing less than 5 percent manganese. The rock is essentially a manganiferous and ferruginous chert, and cannot be considered as a possible source of either manganese or iron because of the extremely high silica content.

No. 21. Mayland Mining Company Claims (Skillen and Means, White Bear). (By Frank S. Simons, August 1, 1942.) The Mayland Mining Company group of claims is in secs. 18 and 19, T. 39 N., R. 11 W., 7.5 miles south of Sawyers Bar near the road from Sawyers Bar to Cecilville, and 2 miles south of the summit of Blue Ridge. The claims are 0.3 mile by trail from the road and 64 miles by road from Yreka, the nearest railroad point. They are held by the Mayland Mining Company, of which J. H. Mills of Los Angeles is the manager. The property comprises five claims, some of which include the White Bear gold mine, now idle. This is the prospect described in Bulletin 76 [1] as the Skillen and Means group of claims.

A thick series of quartz-mica schist, quartzite, and subordinate glaucophane phyllite strikes across a steep ridge near the head of Callahan gulch. The general strike is N. 75° E.; the dip is more or less vertical. The schist is a fine grained sugary rock composed essentially of quartz bands separated by thin partings of fine-grained sericite. The manganese occurs in a granular quartzite which probably represents a metamorphosed chert. The entire series of metamorphic rock could have been derived from Franciscan type sediments, the schist representing the thin-bedded shaly chert common in that group.

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[1] California Min. Bur. Bull. 76, pp. 82, 96, 1918.

The ore body can be traced for about 300 feet down the west side of the ridge, and apparently grades into quartz-mica schist. Relations are not clear, as outcrops are poor. At the crest of the ridge the ore body is 135 feet wide. The ore body extends for 50 feet down the east side of the ridge. It is reasonable to expect that the ore body will continue at least another hundred feet down the east side, unless it is faulted off. It probably grades into quartz-mica schist on the east side also.

The ore is a mixture of quartz and rhodonite. The rhodonite in most of the exposures is completely oxidized. The oxide occurs in seams up to 6 inches in thickness, and can be fairly easily separated from the quartzite. However, very little oxide is present, and the presence of rhodonite in some of the outcrops indicates that the zone of oxidation is shallow. The altered chert is cut by numerous quartz veins, up to 8 inches in thickness. Very little development has been done, numerous small pits having been dug on the more favorable outcrops. None of these pits exposes ore.

No. 22. National Defense (King) Claims. (By Frank S. Simons, August 1, 1942.) The National Defense mining claims are in sec. 16, T. 40 N., R. 10 W., 200 yards northwest of Music Creek, a tributary of South Russian Creek. The claim is 0.8 mile by trail from the Russian Creek road, 2.8 miles from the Sawyers Bar-Etna road, and 50 miles from Yreka, the nearest railroad point. It was located by James Edwards and Mrs. E. Cleveland of Etna on July 10, 1941. The claims lie end to end, with the discovery point at the common and central point. The prospect has also been claimed by Frank M. Ritz of Etna on April 8, 1942. His claim is called the King claim.

A lens of quartzite 60 feet long and 7 feet wide at the thickest part is enclosed in quartz-mica schist. The rocks strike north and dip 25° W. They probably represent a metamorphosed chert lens included in shaly chert. The middle 5 feet of chert contains small amounts of slightly oxidized rhodonite. The rhodonite is intercalated with bands of quartz, usually in irregular patches. Near the center of the exposure is a vertical vein of manganese carbonate from 1 foot to 2 feet in thickness. The carbonate is coarse-grained and gray, and probably contains about 45 percent manganese.

No. 23. Oro Fino No. 1 Prospect. (By Frank S. Simons, August 18, 1942.) The Oro Fino prospect No. 1 is in the NE$\frac{1}{4}$ sec. 17, T. 43 N., R. 9 W., 4 miles by road and half a mile by trail southwest of Fort Jones. The owners are J. E. Lewis and Robert Reynolds. The prospect is on the east side of Oro Fino Valley, near the base of Chaparral Hill. Two open cuts 20 feet apart expose a bed of siliceous manganese oxide ore striking N. 55° W., and dipping 25° NE. The ore bed is about 10 feet thick at the thickest place, and can be traced 75 feet along the strike. The wall rocks are quartz schist. All the rocks are badly faulted, and attitudes and thicknesses are uncertain. No primary ore was seen. The oxide ore contains 25 to 30 percent manganese.

East of the prospect small blocks of low-grade manganese oxide are found in several places over an area half a mile in length and 100 feet in width. Because of lack of exposures, little can be said about reserves, but probably only a small amount of good ore will be found. The country rock is contorted quartz schist and banded quartzite.

No. 24. Oro Fino Prospect No. 2. (By Frank S. Simons, August 18, 1942. The Oro Fino prospect No. 2 is in the SE¼ sec. 17, T. 43 N., R. 9 W., just south of the Oro Fino prospect No. 1 (Siskiyou 23). The owners are J. F. Lewis and Robert Reynolds. An open cut exposes 6 feet of manganese ore striking N. 20° E., and dipping about 90°. The ore is exposed for 20 feet along the strike, the south extension being deeply covered by soil. No outcrops of ore are found to the north. The wall rocks are banded quartzite; and, at some distance from the ore, slate and phyllite are present. The country rock appears to be altered chert and shaly chert. The ore is a peculiar banded quartz-carbonate rock. Numerous ''augen'' or nodules of brown manganese carbonate are found in the quartz layers. Most of the carbonate, however, is gray and is in bands alternating with bands of quartzite. In many places the gray carbonate layers are contorted. A few beds contain nodules of brown carbonate. The presence of manganese carbonate instead of rhodonite is somewhat surprising, considering the metamorphism of the parent chert. A small amount of pale yellow carbonate is also present. Much of the ore is oxidized to thin oxide films on surfaces, but little high-grade ore is present. A run-of-mine sample contained 30 percent manganese. The average ore contains about 50 percent manganese carbonate, or about 25 percent manganese.

No. 25. Pinery Hill Prospect. (By Frank S. Simons, August 19, 1942.) A manganese prospect is said to be on the northwest side of Pinery Hill, the ridge between Oro Fino Valley and Quartz Valley, in sec. 24, T. 43 N., R. 19 W. The land is owned by E. C. Roberts of Yreka. The area is 2.5 miles from Greenview, 8 miles from Fort Jones, and 26 miles from the railroad at Yreka. Pinery Hill is composed largely of contorted banded gray quartzite and quartzitic schist. A few scattered outcrops of siliceous manganese oxide were found, but nothing was seen to indicate the presence of a body of ore of any economic size. The area is brushy, and prospecting is difficult. The property is completely undeveloped, and offers little promise.

No. 26. Rhodonite Claim. (By Frank S. Simons, August 5, 1942.) The Rhodonite claim is in sec. 2, T. 17 N., R. 7 E., 0.3 mile from the Tanner Ridge road on the crest of the ridge between Indian Creek and Thompson Creek. It was located by W. M. Wood and Fred Braun of Happy Camp on March 14, 1941. The claim trends northwest. It is 14 miles from Happy Camp and 85 miles from Yreka, the nearest railroad point. An open cut 40 feet long and a tunnel 20 feet long expose fine-grained quartz-mica schist, striking N. 25° W., and dipping 40° NE. A few beds of sandstone up to 6 inches in thickness are also present. The schist has evidently been derived from thin-bedded shaly chert, the shale layers being rather micaceous now. A lens of siliceous rhodonite ore is exposed in the face of the cut. The lens is 2 feet thick at the thickest part, and pinches bluntly within 3 feet along the strike, at one end. The other end is apparently faulted off. One to 2 feet stratigraphically above this lens is another bed, ranging in thickness from 1 foot to 4 feet. The change in thickness takes place very rapidly along the strike. At the end of the tunnel the schist is faulted against a deeply weathered gabbro.

About 5 tons of material containing about 50 percent rhodonite and 50 percent silica has been mined and is on the stock pile. Some of this rhodonite has been used for gems. A small amount is green and may be johannsenite. About 350 tons of similar material may remain between the outcrop and the fault which cuts off the schist.

No. 27. Scott River Prospect. (By Frank S. Simons, August 18, 1942.) The Scott River prospect is in sec. 3, T. 43 N., R. 9 W., on a steep cliff on the Fort Jones-Greenview road 1 mile southwest of Fort Jones. The property was leased by the West Coast Metals, Ltd., but is idle. Development consists of a bulldozer cut 100 feet long which exposes 3 large and many small angular blocks of siliceous manganese oxide ore embedded in coarse landslide debris. Fifty feet west are outcrops of intensely contorted reddish quartzite and gneissic quartzite. The red color is due to numerous small particles of jasper and red slate. The quartzite strikes east, but the dip is variable. About 10 tons of siliceous ore, averaging 15 percent manganese, are in sight. In a cut 50 feet below is a small fragment of ore containing about 35 percent manganese.

No. 28. Seiad Creek Prospect. (By Frank S. Simons, August 11, 1942.) The Seiad Creek deposit is in sec. 6, T. 46 N., R. 11 W., half a mile by trail from the Seiad Creek road, 3 miles from Seiad Valley, and 51 miles from Yreka, the nearest railroad point. It was located by Cyrus Crawford of Seiad Valley. On the northeast side of a small knob on the northwest side of Seiad Creek, about 600 feet above the creek, is an outcrop of white chert which can be traced northward 100 feet. The chert in places carries thin films of manganese oxide but no ore is present. The prospect is of little value, and no development has been done.

No. 29. Sylvester Prospect. (By Frank S. Simons, August 9, 1942.) The Sylvester prospect is in sec. 20, T. 16 N., R. 8 E., on the east side of Frying Pan Creek, a tributary of the Klamath River. It is owned by George Sylvester of Happy Camp. The prospect is 4 miles by road and 1.5 miles by trail from Happy Camp, and 79 miles from Yreka, the nearest railroad point. Gray slate stained with manganese oxide, striking N. 45° E., and dipping 10° SE., crops out for 80 feet on the east side and 40 feet on the west side of Frying Pan Creek. The continuation of the manganiferous zone is buried by alluvium. The slate ranges in thickness from 2 to 10 feet. At intervals along the outcrop are exposures of quartzite carrying small amounts of rhodonite. The quartzite appears to occur as lenses in slate, but exposures are very poor, the area being covered heavily by brush and soil. All the rocks carry stains of rusty iron oxide. On the east side of the creek on the north end of the outcrop of slate is an exposure of fine-grained porphyritic metadiorite which apparently intrudes the slate as a sill. No ore of commercial importance was seen and probably none will be found. The best rhodonite ore contained about 12 percent manganese, but little ore of this type is present.

No. 30. Walton Prospect. (By Parker D. Trask, September 22, 1942.) The Walton deposit is in the west half of sec. 25, T. 43 N., R. 10 W., 2 miles west of Greenview and 25 miles southwest of Yreka. The deposit is adjacent to a secondary road, but all except 2 miles of the road to Yreka, the nearest rail point, is paved. The deposit is on land owned by M. A. Walton of Greenview. An adit 40 feet in length has been driven northward into the hill, but difficulty was encountered in following the ore. About midway in the adit on the east side, a crosscut 10 feet in length was dug, but no ore was found. The deposit seemingly has not been worked since 1918. The ore body strikes N. 20° W., transverse to the direction of the adit, and dips 25° W. A few boulders of manganese ore lie on the surface of the ground up the hill on the projection of the strike, 50 feet to the northeast, but the ore may not be continuous as it seems lenticular where exposed near the mouth of the adit. The ore body is in recrystallized thin-bedded chert, which itself apparently is a lens in a sequence of massive metamorphic rocks of moderately basic composition. The maximum thickness of the ore is 4 feet.

All the ore is oxidized, and the primary ore is unknown. By analogy with the Lewis deposits (Siskiyou 18) near Oro Fino, 3 miles to the northeast, the original ore is probably rhodochrosite. All the fragments on the dump are highly oxidized. If the ore had come from rhodonite, it seems likely that it would not be so throughly oxidized. The grade and amount of the ore is low. Some 50 tons of oxide ore averaging 15 to 20 percent is estimated to be present.

No. 31. Wykoff Prospect. (By Parker D. Trask, September 16, 1942.) The Wykoff prospect is located at an altitude of about 4,200 feet near the crest of the Siskiyou Mountains in sec. 3 or 10, T. 18 N., R. 6 E., approximately 1 mile south of the Oregon line. It is about 1.5 miles by trail from Johnson Gulch Gap on the road to Bolan Mountain. The owner is E. H. Wykoff of Cave Junction, Oregon. The distance from Johnson Gulch Gap to Grants Pass, the nearest rail point, is 55 miles. About 15 miles of this route is by good forest road; the remainder is by hard-surfaced road, of which 30 miles is paved.

The manganese is exposed near the mouth of an old adit about 100 feet in length, which was driven for gold. The ore body is about 3 feet thick, and dips 15° E. in the direction of the tunnel. It is enclosed in a body of recrystallized thin-bedded chert studded with limonite pseudomorphs after pyrite. The chert in the back part of the tunnel is intruded by diorite. The ore body dips beneath the floor of the tunnel, but it presumably does not extend more than 40 or 50 feet eastward from the mouth of the adit, because of the intrusion of diorite, which has cut off the chert in the tunnel. All the ore seen in the adit and on the dump was highly oxidized. The average content of manganese is estimated to be 25 percent. The recrystallized character of the chert suggests that the primary ore is rhodonite, but the oxidized ore on the dump suggests rhodochrosite. The presence of pyrite in the chert adjacent to the ore points to hydrothermal alteration of the deposit.

SONOMA COUNTY

No. 1. The Aho (Drum) Mine. (By Max D. Crittenden, Jr., August 11, 1942.) The Aho mine is owned by Al Aho of Cazadero. It is located in the NW¼ SW¼ sec. 15, and SE¼ sec. 16, T. 8 N., R. 12 W., 7 miles from Cazadero on the road to Fort Ross, half a mile from the main highway. The mine is 38 miles from the railroad at Healdsburg. The Aho mine is on the west side of a narrow canyon. The slopes are sufficiently steep so that the ore can be chuted from the workings on the slope of the hill, all the way to the loading platform, a short distance above the creek. The mantle of loose rock and soil above bed rock is 2 or 3 feet deep, and serves to obscure the geology except where it has been removed in the mining operations. The slope is well timbered with trees up to 3 feet in diameter.

The Aho mine was originally discovered by a Mr. Crandall of Healdsburg, and acquired by the present owners by purchase of the land. It was first worked in 1924-26 by a lessee, C. P. Seaburg of Oakland. Following this, the mine lay idle until 1940, when it was leased to C. Dudley DeVilbiss of Oakland who reopened the mine and removed several tons of ore. However, he failed to ship anything before the winter rains prevented trucking, and his lease expired. Early in 1942 the propery was leased to A. E. Humphreys, who operated the mine during the spring months. He removed the last of the oxide ore, then allowed his lease to lapse.

The property was first developed by a series of open cuts along the ore bodies. Following this, the bulldozer was used to cut away the footwall of the middle workings. Adits were run to explore and to remove ore from the lower stope. The upper workings consist of an open cut about 50 feet long by 20 feet wide, and 6 to 8 feet deep. A small adit was run under the cut, so the ore could be removed via the adit.

The middle workings consist of an inclined shaft 20 feet deep at the southwest end of an open cut, 100 by 6 feet, which runs diagonally downward to the northeast where it joins the main middle level made by a bulldozer. Two adits were run from the road level. One is accessible, and the other is covered by debris but was reported to extend northwestward for 200 feet.

The lower workings consist of an adit and three branches, as illustrated in plate 16, connecting to the stope by an ore chute. The branches near the stope are in heavy ground, and are well timbered, but cannot be expected to remain open for more than a few years. A loading chute runs straight down the hill from the middle workings, past the track level from the lower workings to the loading platform on the road above the creek. The total difference in elevation from the upper workings to the road is probably between 250 and 300 feet.

When the property was first visited in 1942, it was idle, but was being released to Verner Allen, who expected to begin operations immediately. The production was 8 cars in 1924 to 1926, averaging 53 percent manganese; and 3 cars in 1942 averaging 45 percent manganese, and 17 percent silica.

The geologic relationships are shown in plate 16. The country rock is chiefly arkosic sandstone and shale, but radiolarian chert is locally common, and nearly everywhere encloses the beds of manganese ore. The ore occurs in three separate bodies. Two are enclosed in thin-bedded red chert, and the third in a fault zone between the chert and a mass of sandstone which lies to the north. The first two presumably represent parts of a single ore lens that has been faulted.

The uppermost ore body is 35 feet long and 10 feet thick. The strike is N. 65° E., and the dip is 30°-40° N. The ore body appears to lens out to the northeast, but is certainly faulted off on the southwest end. The prominent fault surface that cuts the ore strikes a few degrees west of north and dips 60° E.

Beginning 20 feet below the ore body described above, a second body has been exposed by a series of open cuts and drifts, which runs diagonally down the hill to the northeast. The general strike and dip of the ore lenses and of the surrounding chert appears to be similar to that in the upper workings. Here, however, either due to original shape or to subsequent shearing, the form appears to be more markedly lenticular, and the bodies are smaller. Near the southwest end of the open cut a 3-foot face of ore, which appears to be completely surrounded by faults, is exposed in an inclined shaft 20 feet deep. A smaller block of ore is cut by the mouth of the incline, and it seems to be about 2 feet wide and dips into the hill, but is partly covered by debris.

In the main bulldozer open cut, another faulted block of ore is well exposed. It is lenticular and is 20 feet long, 6 feet wide at the center, and about 12 feet deep. Like the other ore bodies, it is bounded by faults. It is offset through the center by a minor vertical fault. About 125 tons of ore has been removed and is on the floor of the open cut, and a similar amount is still in place. About 12 feet stratigraphically below the lenticular body just described, is a thin bed of siliceous ore interbedded with the surrounding red chert.

The lowest ore bed now exposed is in a set of adits that cut the fault zone along which the chert is in contact with the sandstone to the north. About 65 tons of oxide ore was removed from this stope. The strike of the chert-sandstone contact, and the trend of the stope, appear to be roughly northwest, in contrast with the strike of the chert near the first ore bodies. The ore bed is about 50 feet long, and from 1 foot to 3 feet thick. It dips 55° S. In the adit beneath the stope, a small exposure of the primary ore can be seen in the roof and on the east wall, 6 feet south of the chute from the stope. Its relation to the ore that occupied the stope cannot be ascertained. The entire area of these lower workings has been severely faulted.

The primary ore appears to consist largely of silicate, probably neotocite and related minerals of pale tan, brown, or reddish color. The ore is cut by calcite veins. Some blocks consisting entirely of granular brown and tan carbonate ore, are found on the dumps, and bands of carbonate cut irregularly through many of the pieces of the ore in the stock pile in the middle workings. It is estimated that about 10 percent of the mass of the ore consists of brown carbonate. Locally sulphides, apparently pyrite, are found in fractures in the ore. It is thought that the primary ore contains 30 to 35 percent manganese, and more than 25 percent silica.

No. 2. Archambeau Prospect (Lucky Strike). (By E. F. Davis, September 25, 1918.) The Archambeau prospect is owned by William Archambeau of Geyserville, and is leased to Alvin Lampson and Max Schultz of Geyserville. It is held under a mining claim on government land called the Lucky Strike claim. The claims lie in sec. 24, T. 11 N., R. 9 W., northeast of Geyser Peak, a distance of 20 miles by road from Geyserville. It would be necessary to build half a mile of road to reach the prospect. A body of massive jasper is enclosed in thin-bedded radiolarian chert. The chert is pale pink to red and is cut by numerous quartz veins, which strike N. 70° W., and dip 70° S. The massive jasper is traceable for 200 feet, running across a small canyon. It is accompanied by small lenses of siliceous black oxide. The largest of these lenses is about 2 feet thick. The ore is exposed in three small open cuts and about 10 tons of it has been removed. It contains much silica box work, and is traversed by streaks of jaspery silica containing spherical cavities. It is cut by numerous veins of quartz. The silica content averages 30 to 35 percent.

No. 3. Baker Ranch. (By E. F. Davis, June 12, 1918.) The Baker Ranch is owned by Mrs. Harry Baker of Middletown. It is in sec. 31, T. 11 N., R. 8 W., and is 7 miles by road northwest of Middletown. The area contains much radiolarian chert. Float of manganese ore has been discovered at several places. At two points siliceous material heavily stained with manganese oxide has been found, and one body of high-grade ore is present. This high-grade ore is half a mile northwest of what is known as the Fairview house and is just below the road to this house. The ore underlies a bed of massive orange-colored jasper, which strikes east and dips 20° S. into the hill. The property is undeveloped.

The ore is massive red-brown material of comparatively high specific gravity. The outside parts of exposed blocks are coated with high-grade black manganese oxide. Pale pink manganiferous carbonate is also intimately intermixed with the ore. A sample of the exposed ore gave the following result when assayed: manganese, 41.9 percent; and silica, 17.81 percent.

No. 4. Boyer Mine. (By E. F. Davis and F. S. Hudson, August 2, 1917.) The Boyer mine is 10 miles northwest of Geyserville in sec. 31, T. 10 N., R. 10 W. It is owned by S. R. Boyer of Geyserville, and leased to A. W. Copps of San Francisco. The property has been developed in two places. The upper working is an open cut 50 feet long with a maximum depth of 35 feet, following the ore body into the hill. A short crosscut runs off into the hanging wall on the east side. The lower working is an open cut of irregular form, the horizontal dimensions being 15 by 20 feet. The past production is said to have been 700 tons.

In the upper working the ore body trends N. 20° W., and dips 60° to 70° E. The only indication of this thickness is the width of the open cut which averages 6 feet. Due to minor displacements on shearing planes it is impossible to determine with certainty the relation of the ore to the well-bedded red chert and shale, which forms the country rock. Sandstone was encountered in the end of the crosscut; its present position evidently is due to faulting. A small body of soft ore was found between the sandstone and the chert in this crosscut. In the lower working the ore occurs in small bodies in a zone of shearing in the chert. No definite form or relation between the ore bodies could be discerned. The ore is principally psilomelane with a little pyrolusite and a small amount of hydrous manganese silicate. The ore is said to become more siliceous with increasing depth.

No. 5. Dillon and Seefeldt Prospect. (By Spangler Ricker, October 1941.) A prospect owned by Mrs. Dillon and H. Seefeldt of Cazadero is located close to the ocean near Stewarts Point, probably in T. 9 N., R. 14 W. The deposit is said to have produced 36 tons of ore in 1918, but when visited in 1941 all that was seen was a few stains of manganese oxide coating the rocks.

No. 6. Dreamland Mine. (By E. F. Davis, September 26, 1918.) The Dreamland mine, owned by James H. Rowan of Santa Rosa, is in sec. 6, T. 8 N., R. 8 W., 2 miles northwest of Mark West Springs on the Kellogg road. From the mine to Fulton by road is 8 miles, all downhill.

The ore bed is enclosed in thin-bedded radiolarian chert. Overlying the ore, and separating it from the chert above, is a bed of yellowish jasper from 6 to 12 inches thick. The ore bed has a thickness of 18 inches to 2 feet. It is soft black and crystalline, laminated in places with thin streaks of iron oxide. The thin-bedded chert immediately below the ore body is heavily stained with manganese oxide.

The ore crops out at only one place, a small fragment being exposed at the surface. Elsewhere it was originally covered by soil to a depth of 1 foot to 3 feet. It is exposed in a shallow pit occupying a horizontal area about 15 by 15 feet. South of the main pit and below it on the slope several narrow trenches have been dug. They expose loose blocks of ore evidently derived from the ore body above. This deposit is listed also as the property of M. R. Shriver. In 1934 the mine produced 10 tons averaging 50 percent manganese.

No. 7. Foerchler Prospect. (By E. F. Davis, September 27, 1918.) Manganese has been reported on land owned by George A. Foerchler of Santa Rosa, near the south line of sec. 34, T. 8 N., R. 7 W. A body of radiolarian chert containing a few thin lenses of massive yellow jasper is exposed on the property. The chert contains a few stains of manganese. The prospect is of little value.

No. 8. Foss Prospect. (California Min. Bur. Rept. 17, p. 249, 1921.) "C. C. Foss has a manganese prospect on his ranch in sec. 19, T. 11 N., R. 8 E., about one mile above 'The Geysers.' "

No. 9. Hayden Prospect. (Condensed from original description in California Min. Bur. Rept. 22, p. 338, 1926.) J E. Hayden of Cazadero has a manganese deposit near the Aho deposit (Sonoma 1) presumably in sec. 7, T. 8 N., R. 12 W.

No. 10. Holst-Weeks Prospect. (By E. F. Davis and F. S. Hudson, March 2, 1918.) The Holst-Weeks prospect is on the property of F. P. Weeks in the north center of sec. 1, T. 7 N., R. 7 W., about 10 miles by road northeast of Santa Rosa. The deposit is 150 yards south of the summit of a prominent east-west ridge. A small open cut exposes a mass of metamorphosed chert 5 to 7 feet thick. The chert is mostly a lustrous bright yellow variety which alters to an earthy limonitic material. Within the chert are irregular masses of a resinous brown to red and dull buff substance, evidently the result of metamorphism of a mixture of manganiferous opal and siliceous carbonate. Greenstone was observed in place, about 10 yards to the east. The intrusion of this greenstone was doubtless responsible for the metamorphism. Alteration to black oxides of manganese has taken place along joints within the manganiferous material, and black shells have formed locally on the periphery of the chert mass.

Down the hill west of the prospect, the soil carries numerous angular fragments of manganiferous material, which form their black metallic luster and fairly high specific gravity, were regarded as ore of good grade. About 15 tons of this material is in sight at this place. A sample of the material taken for assay gave the following: manganese, 31.44 percent; iron, 1 percent; silica, 39.74 percent.

No. 11. McDonald Property. (By E. F. Davis, June 7, 1918.) In the SW¼ sec. 9, T. 10 N., R. 8 W., manganese ore is exposed on the side of the road from Healdsburg to Pine Flat on land owned by Henry McDonald and leased to Tom Smith. The ore is found in lenses of massive chert and thin-bedded chert, 3 to 4 feet thick, and 15 feet in length. The lenses range in color from white to red and consist mostly of silica. The chert contains small spherules of manganese carbonate. In places are larger aggregates and streaks of siliceous carbonate ore. The oxidation of this material has given rise to a small amount of high-grade oxide ore along fractures in the ore body. The amount of commercial ore is small.

No. 12. O'Connell Prospect. (By Max D. Crittenden, Jr., August 12, 1942.) The O'Connell prospect is in sec. 13, T. 10 N., R. 11 W., on property owned by P. L. Curtis of Skaggs Springs, and leased to R. O'Connell. The deposit is on the north side of Warm Springs Creek, 0.3

mile east of Skaggs Springs. The road crosses the creek opposite the hotel, and follows eastward along the bank to the end of a ridge around which the creek makes a sharp bend to the north. Several small open cuts expose highly sheared bleached red chert of the Franciscan group. One cut shows a body of manganese ore about 4 feet long and 1 foot wide, which is reported to average 47 percent manganese and 12 percent silica. This body is a thin fault sliver which does not continue downward. The shearing is everywhere extreme.

In the highway cuts on the southeast side of the creek, the chert zone is 20 feet thick, and is bounded by fine-grained greenstone both above and below. The general strike is N. 60° W., and the dip is moderate to the northeast. In hopes of finding more ore, an adit was begun 25 feet down the slope from the ore sliver described above. At present two men are employed using a portable compressor and plugger. The adit is nearly 50 feet long, in sheared and hydrothermally altered and bleached chert. The shaly interbeds have formed black gouge that might be mistaken for ore, but no manganese ore was visible.

No. 13. Pine Flat. (By E. F. Davis, June 7, 1918.) In secs. 9 and 10, T. 10 N., R. 8 W., 22 miles from Healdsburg on land owned by W. J. McLean and C. F. Clark of Calistoga, are several areas of radiolarian chert associated with sandstone, and intruded by serpentine and greenstone. At three places small amounts of manganese ore have been found, but no commercial ore is in sight.

No. 14. Sharp Prospect. (By E. F. Davis, September 26, 1918.) The Sharp prospect is in sec. 7, T. 8 N., R. 7 W., 4 miles east of Mark West Springs, and 7 miles west of Calistoga by road. It is owned by Newton Sharp of Santa Rosa. The deposit consists of a somewhat siliceous zone in a greenstone of the Franciscan group. It is heavily stained with manganese and locally carries a few percent of manganese.

No. 15. Warner Property Deposit (Big Bluff). (By E. F. Davis, June 7, 1918.) On the southern end of Paul Warner's property in the SW¼ sec. 10, T. 10 N., R. 8 W., is a deep canyon cut through a body of chert which is invaded by intrusive greenstone. In the creek below the cliffs of chert and basalt are numerous blocks of a hard, yellow-brown material which appears to be a fine granular aggregate of quartz, stained yellow by iron oxide. Some manganese is present in this material as is shown by the fact that the outer parts are coated with black manganese oxide. In a few places a little high-grade ore is found on the surface of these blocks. The yellow-brown material is cut by narrow veins of pink carbonate which appears to be rhodochrosite or manganiferous calcite. The place in the cliffs from which this material comes has not been located. Probability of finding commercial ore here is slight.

In the northern part of sec. 10 a small body of manganese-stained chert is exposed. The chert zone contains layers of massive chert which show admixtures of siliceous ore. No work has been done at this place.

No. 16. Wheeler Prospect. (By E. F. Davis and F. S. Hudson, August 2, 1917.) The Wheeler prospect lies across the creek north of the Boyer Mine (Sonoma 4) in sec. 20, T. 10 N., R. 8 W. A little exploration has been done, and a small amount of good ore has been found.

No. 17. White-O-Ranch Prospect. (By Max D. Crittenden, Jr., August 15, 1942.) The White-O-Ranch prospect is located on the White-O-Ranch, owned by J. L. McEachern of Healdsburg. It is probably in sec. 8, T. 8 N., R. 9 W., about 5 miles southwest of Healdsburg on the Guerneville road. A little shovel work has exposed stained chert of the Franciscan group which contains 5 to 10 percent manganese. The prospect is of little value.

No. 18. Wright Prospect. (By Frank S. Simons, May 1942.) The Wright prospect is in the SE¼ sec. 7, T. 11 N., R. 10 W., 300 feet above the west side of the Russian River. It is on the land of George Wright of Cloverdale, and is 1 mile east of Cloverdale by road, near the Mendocino County boundary. Fifty feet above the road a shallow open cut exposes brecciated white chert, carrying films of manganese on fracture surfaces. The best ore carries less than 10 percent manganese. Two hundred feet southeast an open cut 50 feet long and a tunnel 40 feet long expose interbedded brown and white chert striking N. 15° E., and dipping 45° E. Manganese occurs as thin films on joint and bedding surfaces, but no ore carries more than 10 percent manganese. The ore is too low in grade to be commercially useful.

STANISLAUS COUNTY

A large number of manganese deposits are found in the southwest part of Stanislaus County. The geology of this region has been described above in connection with the account of the Ladd-Buckeye area in the chapter on San Joaquin County and in the description of the Black Wonder area in the chapter on Santa Clara County. The location of many of the deposits is shown on plates 4 and 11.

No. 1. Black Bolt Claim. (By Frank S. Simons and Parker D. Trask, October 1941.) The Black Bolt claim is about 1,000 feet northwest of the Mary Lou claim (Stanislaus 19) in the northeast part of sec. 21, T. 6 S., R. 5 E. (pl. 11, deposit 17). It was located by J. T. Renfrew, J. W. Bonsack, and Ralph Bolt on January 29, 1941. The ore consists of siliceous manganese oxide in an erosional remnant of white chert, which dips 20° NE., and lies on sandstone. A shaft 7 feet deep in the sandstone discloses no additional ore. The grade is of the order of 15 percent manganese.

No. 2. Black Mike Claim (Black Point, Black Rock). (By Frank S. Simons and Parker D. Trask, November 1941.) The Black Mike claim is 0.3 mile north of Del Puerto Creek in the NE¼ sec. 14, T. 6 S., R. 5 E. (pl. 11, deposit 15). It was located by Harold Tripp on January 20, 1940. Another claim on the same deposit, called the Black Point, was located by J. W. Bonsack, November 6, 1941. A claim called the Black Rock was located on this deposit by Mrs. Mildred Taylor, but the date of location is not known. Development consists of removal of a little overburden and one trench at the northwest end. The ore body is exposed for 54 feet, striking southeast and dipping 50° to 65° NE. The average width is 6 feet and the maximum 11 feet. The hanging wall is shaly chert and the footwall is massive chert, which suggest that the deposit may be overturned. The walls diverge downward. A large mass of serpentine and related rocks is 100 yards to the west and a small intrusion of greenstone is found between the ore body and the serpentine. The ore is low in grade, averaging not more than 25 percent manganese. The areal limits of the ore body are well defined on the surface of the ground. Owing to the relatively great width of the ore body and the apparent divergence of the walls downward, additional exploration at depth might be warranted. However, the ore body and the wall rocks are cut by numerous quartz veins, which suggests hydrothermal action. The ore may vary in grade with depth.

No. 3. Brinkerhoffer (Brown) Mine. (By R. R. Morse, November 9, 1918.) The Brinkerhoffer or Brown mine is near the summit of a sharp ridge extending eastward from Mt. Oso, at an elevation of about 1,900 feet, near the center of sec. 18, T. 5 S., R. 6 E. The original locators, among whom were a Mr. Runner and a Mr. Brinkerhoffer, constructed a road connecting the Clear Creek-Ingram Canyon road with the mine. These men mined 40 tons of shipping ore. The claim, road, and ore were then sold to a Mr. Brown, who transported the ore to the railroad, received payment for the ore, and then abandoned the prospect without further mining. The manganese occurs in the shape of a short lens, in and near the center of a sharp crumple in a bed of platy red chert, overlying sandstone and serpentine. The ore has been exposed in short inclined cuts. The length of the outcrop of ore is about 80 feet. Faces average 2.5 feet thick. These faces show massive oxide ore with a homogeneous submetallic luster, in a gangue requiring careful sorting to produce ore of shipping grade. The strike varies from northwest to southwest, describing in the outcrops a roughly horseshoe-shaped curve, the fold plunging about 30° N. The lens of ore occurs in the axial region of a sharp anticlinal crumple, and in this regard duplicates the occurrence at the Buckeye mine (Stanislaus 4).

No. 4. Buckeye Mine. (By Parker D. Trask, December 1942.) The Buckeye mine is located in secs. 2 and 3, T. 5 S., R. 5 E., in Stanislaus County. It is 23 miles by road from Tracy, and 16 miles from Vernalis, the nearest railroad shipping point. The mine was leased to M. A. Wright of Berkeley in 1917, and in 1918 the lease was transferred to the Suffern Company. Between 1917 and 1919 the mine produced 13,373 tons averaging 44 percent manganese. It was operated for a short time by F. M. Doak in 1929, who shipped 44 tons of ore containing 52 percent manganese. The mine was leased to Malcolm H. Carpenter, Tasker H. Oddie, and F. M. Doak of San Francisco in 1940, and later in the year their lease was transferred to Verner Allen of San Francisco, who is now operating the property. By the end of 1941 the last operators had taken about 1,000 tons of high-grade oxide from the mine. In 1941 the U. S. Bureau of Mines drilled four holes in the north ore bed and sampled the mine extensively. The U. S. Geological Survey mapped the mine and surrounding country in detail during the summer of 1941. The geologists associated with this work were S. G. Lasky, W. G. Pierce, Frank S. Simons, Parker D. Trask, and Charles R. Warren. The geology adjacent to the mine was mapped by Pierce and Trask (pl. 17). Maps of the mine workings were made by Lasky, Simons, and Warren. In July 1944 Max D. Crittenden, Jr., visited the area and brought the mine maps up to date (pl. 18). Crittenden's statement of the development between 1942 and 1944 is given below.

The ore is in two white chert zones, interbedded in a body of red chert 2,000 feet thick. The ore beds are 600 feet apart, and are designated as the north and south ore beds respectively. The limits of both ore beds have been indicated rather definitely by mining and prospecting. Both beds consist of massive ore.

The north ore bed is 220 feet in length and 200 feet in depth. The maximum thickness is 11 feet, and the average thickness is 8 feet. The ore body is sharply flexed at both ends. It strikes west and dips 50° to 60°

N. The upper 50 feet of ore consists of oxide, below which is gray rhodochrosite and bementite. Prior to World War II the ore body was mined in a large open cut and from two levels. The lowest working at that time was about 100 feet beneath the highest surface outcrops. Drill hole No. 3 of the U. S. Bureau of Mines at a point 100 feet below the lowest level encountered 20 feet of low-grade carbonate ore containing 5 to 15 percent manganese, at a distance of 420 feet from the surface (pl. 18). The other drill holes struck no ore.

The south ore bed is found in a manganiferous zone that can be traced for more than 600 feet along the strike. It has been operated from two adits, about 30 feet apart, and from a winze and lower level about 20 feet below the main level (pl. 18). The strike of the ore is east and the dip is 30° to 45° N. The outlines of the ore body have been delineated by the recent workings, which indicate that it is about 125 feet long and 100 feet down the dip. The maximum thickness is 9 feet and the average thickness is 5 feet.

The ore above the level of the winze is mostly massive dense black oxide, but in the winze level only about one-half the ore is oxide, the rest being carbonate; also, the silica content is greater than in the workings above. In the east adit, driven along the outcrop of the ore body 100 feet below the main level, only a little bementite mixed with chert was found. Consequently, the high-grade ore probably does not extend much beyond the level of the winze.

Buckeye Mine. (By Max D. Crittenden, Jr., 1944.) The principal development in the north ore bed between 1942 and 1944 was an adit at altitude 1,837 feet, 350 feet down the hill slope from the original outcrop, which intersected the ore at a distance of 300 feet from the portal (pl. 18). The ore bed was followed by drifting 95 feet west, and 66 feet east, of the main crosscut. By the summer of 1944 the ore body had been almost entirely stoped from the 1,837-foot level to the open cut. Ore was then being mined below the adit level by means of a sublevel at an altitude of 1,805 feet.

The north ore body has been mined from the original surface to the 1,805-foot sublevel, a distance of 225 feet down the dip. The strike length of the ore body was 180 feet on the 1,925-foot level, 190 feet on the 1,890-foot level, and 140 feet on the 1,837-foot level. The average thickness appears to be about 8 feet throughout the minable portion, with a minimum of 2 feet and a maximum of 12 feet. The broadly tabular form of the body is probably original; the twists and sharp folds seemingly are the result of compressional forces that deformed the ore bed, and its enclosing rocks. The extent of ore along the strike is determined largely by a change in manganese content, rather than by decrease in thickness (pl. 18). The ore minerals gradually become less abundant and give place to chalcedonic quartz which occupies the entire width between the chert walls. In places rhodochrosite or manganiferous chert are found in the chert adjacent to the ore bed. The massive quartz grades into chert along the strike.

The primary ore is an exceedingly massive and intimate mixture of the following minerals, listed in approximate order of abundance: (1) massive gray manganese carbonate; (2) massive reddish-brown braunite and hausmannite (?); (3) pale brown or tan hydrous manganese silicates; (4) bright pink rhodochrosite; (5) resinous brown neotocite; (6) rhodonite; (7) inesite; and (8) metallic sulfides. The average grade of the primary ore shipped has been approximately 38.5 percent manganese, 1 percent iron, and 15 percent silica. However, hand specimens averaging 45 to 50 percent manganese are obtainable.

The exact sequence of the ore minerals remains to be determined by laboratory study. However, it is possible to separate them into two groups by cursory examination of the hand specimens. It is uncertain whether all of the minerals of Group I are the "original" minerals deposited on the sea floor, or whether, as is usually assumed, the braunite and hausmannite are products of metamorphic change. These two groups of minerals are listed below.

Group I (older minerals)

- Massive gray manganese carbonate
- Reddish brown braunite and hausmannite (?)
- Manganiferous chert (?)

Group II (clearly later hydrothermal minerals)

- Bright pink rhodochrosite
- Quartz
- Rhodonite
- Inesite
- Metallic sulfides (including MoS_2)
- Pale brown or tan hydrous manganese silicates
- Clear resinous neotocite

The oxide ore in the south ore body has been entirely mined out except for a few pillars which will soon be inaccessible. The primary ore exposed on the margins of the oxide is too thin and low grade to constitute ore under any circumstances. The north ore body was virtually mined out above the 1,837-foot level in July 1944. Since then, over 1,500 tons of ore has been mined from below that level.

A crusher and rotary kiln were installed just below the portal of the adit in 1943 to produce a calcined product meeting the specifications of the Metals Reserve Company. The kiln however was operated for only a short time before the Metals Reserve Company specifications were changed so that the carbonate ore could be shipped directly.

The production of the Buckeye mine is summarized in the following table.

Table 5. Production of manganese ore from the Buckeye mine, Stanislaus County, California

Year	Production in long tons	Mn	Fe	SiO_2	H_2O
		Percent			
1917	400	55.0	0.8	9.0	
1918	3,046	44.5	1.0	14.0	
	1,040	49.0			
1919	8,887	42.0	0.09	14.5	
1929	44	52.0			
1941	809	48.8			
1942	3,592	45.0	1.8	14.0	5.0
1943	4,476	39.0	1.0	15.0	
1944 (to June 30)	3,569	37.5	1.0	15.0	2.0
	25,863	42.28	1.0+	14.5	3.0+

No. 5. Claim 14. (By Frank S. Simons and Parker D. Trask, October 1941.) A claim of unknown ownership called Claim 14 is about 1 mile southeast of the Look Out claim in sec. 15, T. 6 S., R. 5 E. (pl. 11, deposit 14). Ore is exposed in two places 130 feet apart along a north south line. The ore bed may be continuous between the two exposures, but no float was seen between them. An open cut, now caved, has been dug at the north exposure. Here the ore body is incompletely exposed, but is

probably about 6 feet wide. At the south exposure the ore crops out for 20 feet. The ore is siliceous oxide containing about 15 percent manganese. The average width is not known because of lack of exposures. The strike is north and the dip 65° W.

No. 6. Clear Creek Deposit (Cummings). (By R. R. Morse and F. S. Hudson, November 9, 1918.) J. J. Cummings and Son have shipped three cars of ore during the past summer from their surface workings in Clear Creek Fork of Ingram Canyon, near the center of sec. 19, T. 5 S., R. 6 E. The ore is found in chert which overlies sandstone. The length of the ore body exposed at the surface is 30 feet, the ore appearing to lens out at each end of the outcrop. The thickness of this bed of oxide ore varies between 1 foot and 4 feet, averaging about 2 feet. The ore is badly mixed with silica, principally in the form of chert. The ore bed occurs about 40 feet above massive sandstone. The ore was extracted from shallow inclines sunk from the outcrop. A tunnel started 60 feet below the outcrop of the ore bed failed to intersect the bed, being carried forward in the sandstone to a length of 100 feet. The strike of the ore ledge is N. 70° W., and the dip is 25° S. Marketable ore still remains in the faces of the inclines. The grade of the best ore is 40 percent manganese and 15 to 20 percent silica.

No. 7. Coast Manganese Mine. (By Ivan F. Wilson, November 24, 1942.) The Coast Manganese mine is 1 mile south of the Buckeye mine (Stanislaus 4), approximately in sec. 11, T. 5 S., R. 5 E. Operations were started in November 1942 by the Coast Manganese Company. Five men are working on the property. A road 0.9 mile in length has been constructed. This road turns off from the road to the Buckeye mine (Stanislaus 4) at the foot of the steep slope just below that mine. A tunnel 30 feet long, and a shaft 10 feet deep have been opened. According to the operators 29 tons of ore has been shipped, but the grade of this shipment was not ascertained. A bed of shaly black oxide ore 1.5 feet thick is enclosed in massive red and white chert, which in turn is interbedded in thin-bedded red and gray to green shaly chert and shale. The ore bed strikes east to N. 45° E., and dips 45° to 60° NW. It is locally warped and wrinkled. The thickness of the bed ranges from 1 foot to 2 feet, averaging 1.5 feet for the length of the tunnel and for the length of outcrop on the surface. The ore bed is exposed in a shaft 90 feet east of the mouth of the tunnel, and crops out on the surface 45 feet farther east, for a total outcrop length of 135 feet. The ore is black oxide, both the minutely botryoidal hard psilomelane type, and soft black oxide. It contains patches of cellular silica stained with limonite. The average grade is 30 to 35 percent manganese.

No. 8. Crocker Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 83, 1918.) A deposit owned by M. I. Crocker of San Francisco is located in sec. 33, T. 5 S., R. 6 E., in the mountainous area in the northwest part of Stanislaus County 5 miles southeast of Mt. Oso. The property is undeveloped.

No. 9. Gerber Deposit. (By Frank S. Simons, October 1942.) The Gerber deposit is 0.3 mile southeast of the Jones group (Santa Clara 19) in the SE¼ sec. 27, T. 6 S., R. 5 E. (pl. 11, deposit 20). It is leased to William Crittenden of San Francisco, and is now active. Ore is being sent to the General Dry Battery plant at Patterson. The production figures are combined with those of the Jones group. An adit and stope are on the property. The ore is low-grade siliceous oxide. It occurs in a bed 80 feet long, and 1.5 to 5 feet thick, averaging 2.5 feet in thickness. The strike ranges from northeast to northwest, and the dip is 20° to 40° N. The grade is estimated to be 25 percent manganese.

No. 10. Grayson Claim. (Modified slightly from original description in California Min. Bur. Rept. 11, p. 465, 1893.) The Grayson prospect is in sec. 25, T. 6 S., R. 5 E., 2 miles east of the Park group (Stanislaus 22). A mine of similar name lies about 4 miles to the east. No work was being done on either claim at that time (1893), but cinnabar is said to have been taken from the old workings on this claim. The top of the hill immediately east of the Summit mine (Stanislaus 25) on which the Grayson claim is situated, rises to a height of nearly 3,000 feet above sea level. From the divide, above the Summit mine, to the top of the hill, siliceous rocks crop out, and at the top of the hill is a considerable showing of manganese.

No. 11. Grummett-Knox Mine. (By Parker D. Trask and W. G. Pierce, November 1941.) The Grummett-Knox mine is in sec. 6, T. 5 S., R. 6 E., on the north side of the road, about 100 yards below the Grummett ranch house (pl. 4). It is on Grummett Creek about 1 mile east of the Tip Top mine (Stanislaus 28). The mine was leased in 1918 to Mr. Knox of Modesto, by William Grummett, the owner of the land. Three adits were opened and 50 tons of ore containing 35 percent manganese was shipped. The mine has recently been reopened, and Mr. Rutherford has shipped 72 tons of ore containing 30 percent manganese. Three ore beds 1 foot to 3 feet thick are found within a stratigraphic interval of 20 feet. They are exposed along the strike for 40 feet. The ore is disseminated oxide in chert. The strike is east and the dip 70° N. The average ore contains 25 percent manganese.

No. 12. Grummett No. 2 Deposit. (By R. R. Morse and F. S. Hudson, November 7, 1918.) The Grummett No. 2 deposit is on the property of A. Grummett in the SE¼ sec. 6, T. 5 S., R. 6 E., Stanislaus County, half a mile south of the Grummett-Knox mine (Stanislaus 11). It is on a knoll south of Spring Creek, one of the branches of Ingram Canyon. The distance by road to the shipping point, Westley, on the Southern Pacific Railroad, is 11 miles. Two workings are 120 yards apart on an ore zone which trends N. 60° E. At the western workings, the ore zone has been proved for 60 feet along the strike and to a maximum depth of 30 feet below the highest outcrop. Manganese occurs as black oxide in the form of stains, layers, and pockets, in the upper part of a bed of massive white chert, which dips 65° N. The enclosing rock is thin-bedded chert. The ore-bearing layer ranges from 6 inches to 1 foot in thickness.

In the eastern working the ore occurs in the same manner as in the western deposit. The strike here is N. 20° E., the dip 75° E. About 5 tons of ore has been obtained from a shallow pit. The ore in place is of lower grade than that of the western working. Nothing was seen here to encourage further work.

No. 13. Hamilton Deposit (Mitchell, Hospital Canyon). (From files of U. S. Geological Survey, 1918 and 1942.) A deposit formerly owned by Mitchell and Strickland, but now owned by J. P. Warren of San Francisco, is in sec. 15 or 27, T. 5 S., R. 5 E., on the headwaters of Hospital Canyon, 17 miles from Vernalis. The production in 1917 was 300 tons containing 54 percent manganese and 6 percent silica; and in 1918 it was 159 tons containing 42 percent manganese and 16.7 percent silica. The property is said to have been worked in 1942 in preparation for shipping ore to the General Dry Battery plant at Patterson.

No. 14. Hammond Prospect. (By E. F. Davis and F. S. Hudson, October 28, 1917.) A prospect owned by W. J. Hammond of Patterson is located in sec. 8, T. 6 S., R. 6 E., about 75 yards southeast of the Mineral Products Company's railroad, 350 yards above "Magnesia Camp." The latter place is 15 miles from Patterson. A small creek flows northwestward through the property to join Puerto Creek 100 yards away. The ore body is associated with chert which shows the effects of igneous metamorphism, but only a minor amount of this rock is exposed here. Most of the rocks in the neighborhood are igneous. Amygdaloidal greenstone is seen in place a few yards southeast of the deposit. On the northwest and northeast, a few yards from the deposit, greenstone is also found. Fifty yards northeast is an outcrop of granite porphyry varying from coarse granular to almost aphanitic texture. The elongated nature of this outcrop, with amygdaloidal greenstone in place on both sides, suggests that the granitic material is intrusive into the basaltic rock.

Two open cuts are on the property, the principal one being located at the point where the ore body is crossed by the creek, the second is about 75 feet to the northeast. The south working exposes the ore body for 40 feet in a northwest direction. This seems to be the thickness of the deposit, but no definite structure planes were seen. The ore consists of a deep red, reddish-brown, or almost black material with a resinous luster. Patches of hematite and of maroon-colored, dense chert occur in it. Some specimens show manganese oxide in veins, traversing the other material. On the dump a few pieces of red chert carrying highly lustrous films of manganese oxide were found. In one specimen an irregular patch of white and buff crystalline carbonate was seen. The carbonate appears to have been formed earlier than the resinous material.

At the northern prospect, material of similar nature is exposed. More metamorphosed chert is seen here in association with the ore than at the southern working. The ore bed is not exposed in place at the northern prospect. Rounded blocks of the hematitic material with peripheral shells of higher manganese content lie heaped together on the surface. On the southeast side of the open cut, some of these blocks are partly enclosed in gray-green shale, whose unaltered appearance leads one to suspect that they owe their present position to faulting. One specimen of chert showed spherules of manganese oxide.

The ore body may be traced between the two workings. At the outcrop it has been altered to a mixture of limonite and silica with no apparent manganese oxide. A belt of metamorphosed chert 10 to 30 feet wide, and rich in limonite, separates the ore from the amygdaloidal rocks to the southeast. Some chert was found carrying patches of yellow opal. From this relationship it seems evident that the limonite of the chert is derived from the same type of material as that seen in the outcrop of the ore body, viz., hematitic opal. The manganese content of the ore body is probably less than 5 percent. The ore presumably contains 50 percent silica, the balance being iron oxide. No commercial ore was seen, and as the ore body is fairly well opened up, farther exploration seems inadvisable.

No. 15. Jake Smith Prospect. (From files of U. S. Geological Survey, 1942.) The Jake Smith prospect is near the Hamilton (Stanislaus 13) deposit, probably in sec. 22, T. 5 S., R. 5 E., about 17 miles from Vernalis. It is owned by J. P. Warren, and in November 1942, 17 tons of ore containing 20 percent manganese are reported to have been shipped to the General Dry Battery plant at Patterson.

No. 16. Liberty Mine. (By W. G. Pierce and Parker D. Trask, November 1942.) The Liberty mine is in the SW¼ sec. 36, T. 4 S., R. 5 E., about 1.5 miles northeast of the Buckeye mine (Stanislaus 4). The mine was first operated in 1918 by C. C. Garrison, R. A. Delugge, and W. F. and H. H. Houser of Los Angeles. Between 1918 and 1926 it produced 2,250 tons of oxide ore averaging 46 percent manganese and 8 percent silica. The mine is said now to be owned by M. A. Wright. The mine was taken over by the Humphreys Gold Company in the summer of 1941. During 1942 this company produced 734 tons to November 15. The ore was shipped to the Generay Dry Battery Company plant.

The relationships of the ore bodies to the surrounding rocks are shown in plates 19 and 20. The ore lies in chert of the Franciscan group. It has been mined from one level and stoped to the surface. A lower tunnel 100 feet below the main level encountered no ore. A raise was driven upward from the lower tunnel for more than 75 feet along a low-grade chert zone, which seems to be the continuation of the ore body above, but no commercial ore was found. The ore body in the main working was found to pinch out about 20 feet below the floor of the adit in an underhand stope. The ore is in three bodies, each of which is separated by a fault. They might all be part of one ore body or they might be part of two ore bodies. The two east ore bodies are definitely the faulted parts of one ore body, but the relationships between the westernmost ore body and the two eastern ones is not certain, though on the ends which face each other they are terminated by faults which caused a drag that indicates displacement of the west ore body to the west.

The length of the ore zone is 300 feet. The westernmost ore body attains a maximum width of 8 feet, but averages about 6 feet. It seems to terminate at the west end of the present workings, but a fault at this position indicates that possibly some ore might be found west of the end of the present ore body. The eastern two ore bodies are about 3 feet in thickness. The total depth of the ore body as exposed in the stopes is 100 feet. The easternmost ore body has been mined during 1942, but it is nearing depletion and probably does not contain over 200 additional tons of high-grade ore. As the ore bodies seem to play out about at the level of the main adit, the prospects for additional reserves are small.

No. 17. Look Out Claim. (By Frank S. Simons and Parker D. Trask, October 1941.) The Look Out claim (pl. 11, deposit 13) is 0.8 mile north of Del Puerto Creek in sec. 10, T. 6 S., R. 5 E. It was located by Mary Lou Thronson on March 12, 1941. Five open cuts and two trenches have been opened. The ore is exposed at irregular intervals for 160 feet. The strike is northeast and the dip 50° to 70° NW. The average width is 1 foot and the maximum is 3 feet. The walls of the ore body probably converge downward. The ore is siliceous black oxide in massive white chert. The grade is richest at the north end where it is about 25 percent manganese, and leanest at the south end where is is approximately 5 percent manganese. The limits of the ore body have been well defined by current exploration, and additional prospecting is not likely to indicate more ore.

No. 18. Magnesia Camp. (By E. F. Davis and F. S. Hudson, October 28, 1917.) A manganese prospect is located on the right of way of the Patterson and Western Railroad in sec. 8, T. 6 S., R. 6 E., just

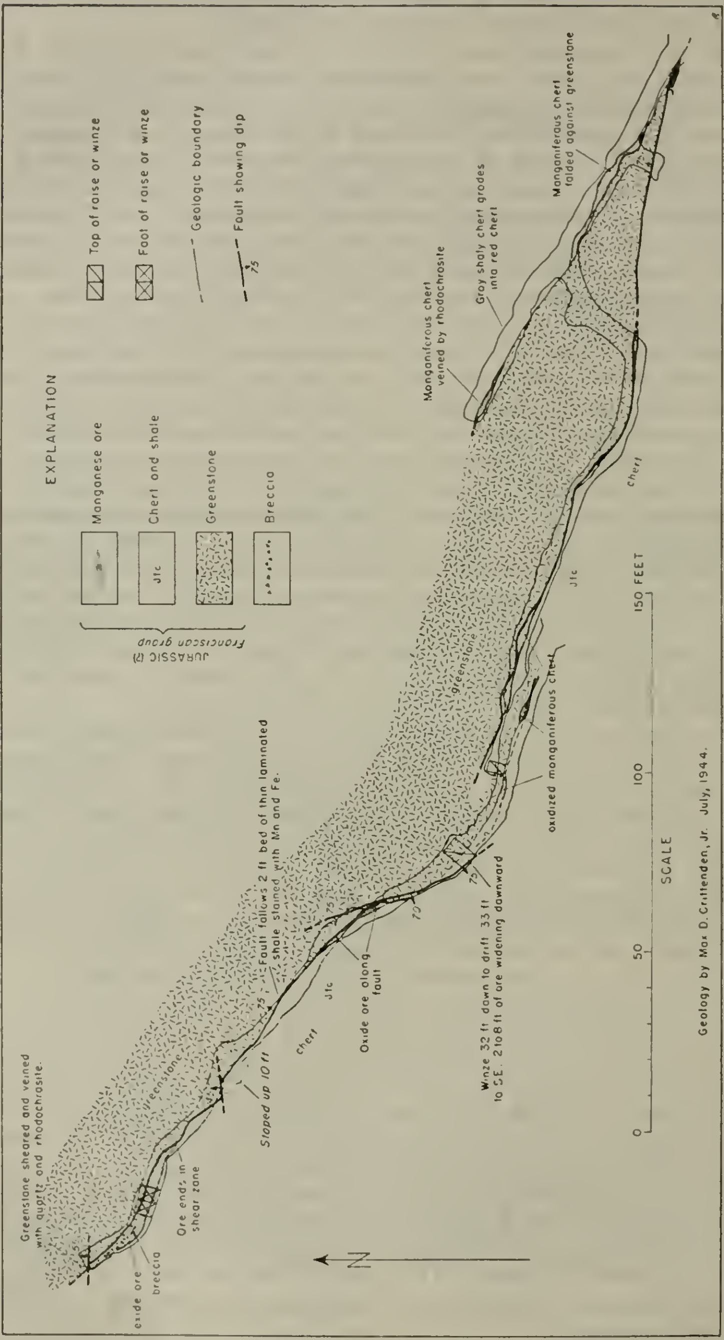
EXPLANATION
Manganese ore
Chert and shale
Jfc
Greenstone
Breccia
JURASSIC (?)
Franciscan group
Top of raise or winze
Foot of raise or winze
Geologic boundary
Fault showing dip
75
Greenstone sheared and veined with quartz and rhodochrosite
oxide ore
breccia
Ore ends in shear zone
Stoped up 10 ft
Fault follows 2 ft bed of thin laminated shale stained with Mn and Fe
chert
Jfc
Oxide ore along fault
Winze 32 ft down to drift 33 ft to S.E. 2108 ft of ore widening downward
oxidized manganiferous chert
manganiferous chert
Greenstone
Greenstone
Manganiferous chert veined by rhodochrosite
Gray shaly chert grades into red chert
Manganiferous chert folded against greenstone
chert
Jfc
75
70
N
SCALE
0
50
100
150 FEET
Geology by Max D. Crittenden, Jr. July, 1944.

FIGURE 8. Geologic map of the Moran Brothers mine, Stanislaus County, California.

south of the "Magnesia Camp" about 15 miles from Patterson. A small body of oxide ore is exposed here in an open cut on the east side of the track for a distance of 20 feet along the strike of the ore body. The ore body is 3 feet thick and lies enclosed in, and parallel to, beds of thin-bedded, green radiolarian chert which strike N. 50° E., and dip 60° E. The contact between the ore body and the thin-bedded chert on each side is sharp and distinct. Near the ends of the ore body the rock becomes gradually more siliceous, and the outer 2 inches of the ore lens are gray chert banded with a few small streaks of manganese. The ore body is separated from the thin-bedded green chert by a shale parting. The ore contains a few skeletons of silica, and is cut by quartz veins. It contains at least 20 percent silica, and from 35 to 40 percent manganese. The amount of good ore now in sight is small, but further work on the prospect is advisable.

No. 19. Mary Lou No. 1. (By Frank S. Simons and Parker D. Trask, October 1941.) The Mary Lou No. 1 claim is on the west side of Peachtree Creek in the east part of sec. 21, T. 6 S., R. 5 E. (pl. 11, deposit 16). It was located by Mary Lou Thronson on March 15, 1941. Five trenches and one open cut have been dug. The ore body is exposed along the strike for 145 feet. The average width is 1.5 feet and the maximum 2 feet. The bed is gently folded in such a way that the outcrop is S-shaped. The dip ranges from 15° to 30° W. The ore is mainly siliceous black oxide averaging about 25 percent manganese. Some of the ore however is massive and may contain as much as 40 percent manganese. The grade is poorest at the south end where the ore body pinches out. The ore body presumably is truncated by a fault at the north end, but the continuation could not be found.

No. 20. Mezzero Deposit. (By Parker D. Trask, November 1942.) The Mezzero deposit is in the SW¼ sec. 6, T. 5 S., R. 6 E., on the Grummett Ranch, about a quarter of a mile southwest of the Grummett-Knox mine (Stanislaus 11) on the south side of the road near the top of the first hill. Some 120 tons of oxide ore were shipped to the General Dry Battery Company in the fall of 1942. The ore came from a pit about 30 feet long, 15 feet wide, and 3 feet deep. The strike is northeast and the dip vertical. The ore body was a lens in thin-bedded white schist, and seems to have been completely mined out.

No. 21. The Moran Brothers (Moy) Mine. (By Max D. Crittenden, Jr., July 1944.) The Moran Brothers mine is approximately in the center of the SW¼SE¼ sec. 36, T. 4 S., R. 5 E., 0.3 mile southeast of the Liberty mine (Stanislaus 16). The property is owned by Peter Moy of Stockton, and was leased in 1918 to Moran Brothers and George J. Donaldson. The lease was held by the Barker Corporation in 1944. Production was 153 tons in 1918 averaging 45 percent manganese and 15 percent silica; and 26 tons in 1943 averaging 33.2 percent manganese.

Two adits have been opened (fig. 8). The recent production has come from the higher adits on the west side of the ravine. In July 1944 the lower adit was extended, and a raise was being driven toward an ore body exposed in the winze below the upper level.

The manganese at the Moran Brothers mine is of particular interest because of the intimate association of the manganiferous lenses with greenstone. The geologic relationships at the mine are shown in plate 4 and in figure 8. Throughout the Franciscan group in California, manganese commonly occurs in the same area as greenstone, but it is relatively uncommon to find it in contact with greenstone. Here the manganese occurs as lenses of manganiferous carbonate 1 foot to 6 feet thick, lying on both sides of a body of greenstone 30 feet thick, and 500 feet long. Typical thin-bedded chert of the Franciscan occurs both above and below the greenstone. Seven manganiferous lenses are exposed along the south (footwall) contact of the greenstone over a total distance of 370 feet. The north contact is exposed in the workings for 120 feet, in which space are two lenses. The greenstone body pinches out at the portal of the lower adit, and the two zones of manganese join at this place.

The nature of the greenstone body is not immediately apparent, since there is no obvious pillow structure, induration, or metamorphism of the adjacent rock. Conceivably the body might be a sill, but if so it appears strange that a sill would be so intruded as to split a manganiferous zone leaving remnants on each side. This feature, together with the absence of thermal metamorphic effects, suggests that the body is a submarine flow, which covered over the manganiferous lenses on the footwall side. The continued deposition of manganese and silica then produced new lenses of ore on its surface, and on the chert which overlies the greenstone.

The primary ore, where exposed, is a mixture of manganiferous chert and manganese carbonate. Veins of pink rhodochrosite were observed cutting the original ore in the face of the north branch of the lower adit. The minable ore results from oxidation and enrichment of the low-grade primary ore. It is unlikely that more than a few tons of such ore remain.

No. 22. Park Group. (By Frank S. Simons and Parker D. Trask, October 1941.) The Park group of deposits is in SE¼ sec. 21, T. 6 S., R. 5 E. (pl. 11, deposit 19). The names of the owners or locators are not known. Three deposits of manganese called the north, west, and east ore bodies are in the Park group. They all lie east of the road at the saddle on the main divide within an area 100 yards in diameter. Each deposit has been prospected by trenches. The ore consists of low-grade manganese oxide in white chert. The north ore body is the largest. It consists of two exposures 120 feet apart. It could not be traced continuously in the interval between outcrops. The average width is 8 feet and the maximum is 11 feet. The bed strikes east and dips 70° S. at the east end, and 40° S. at the west end. The hanging wall is massive white chert, and the footwall is thin-bedded buff chert. At the west end the walls of the ore body converge downward; at the east end they are parallel. The outcrop therefore probably is near the center or in the lower part of the original lens of ore. The average manganese content is of the order of 15 percent, though pockets of ore containing 30 percent or more of manganese are present.

The west deposit is 100 yards southwest of the north ore body. It is 50 feet long and has an average width of 3 feet. The maximum width is 5 feet. The strike is N. 60° E., and the dip 60° to 70° SE. The ore bed is folded slightly, thus causing the outcrop to be sinuous. The average grade is about 25 percent manganese. The richest ore is at the west end. The east deposit lies 200 feet east of the west deposit, just north of the county boundary. The ore body is exposed in a cut 18 feet long and 6 feet wide. It is broken by many small faults, and its continuation could not be traced. In places it is as much as 5 feet wide. The average grade is about 30 percent manganese.

No. 23. Section 23 Mine. (By Ivan F. Wilson, November 24, 1942.) The Section 23 mine is in sec. 23, T. 5 S., R. 5 E., in Hospital Canyon, about 1 mile northeast of the Hamilton (Stanislaus 13) deposit. It is owned by J. P. Warren. The 1942 production was 570 tons to November 15, the ore having been sent to the General Dry Battery plant at Patterson. At the time of the writer's visit, operations had ceased, presumably because of the low grade of the ore. This mine contains a very thick body of low-grade "stockwork" ore, similar in appearance to the low-grade ore at the Ladd mine (San Joaquin 5). The ore bed is 18 to 20 feet thick and is exposed for a length of 73 feet and a width of 32 feet. There are no exposures on either side and the linear dimensions may be considerably greater. The bed is nearly flat, but the attitude is locally variable and the bed is cut by several faults of small displacement. The ore zone consists of massive white chert penetrated with manganese oxide, mostly of the psilomelane type. The grade ranges from 10 to 30 percent manganese, averaging perhaps 15 percent.

Ore has been stoped from an elbow-shaped tunnel, 30 feet long to the southwest and 24 feet long to the southeast. It is 8 to 10 feet high. This tunnel is joined on the northeast by an open cut 43 feet in length and up to 32 feet in width with a depth of 18 feet. A prominent slickensided fault surface appears on the northeast wall of the open cut. This surface strikes N. 10° W., and dips 65° E.; the displacement seems small. About 50 tons of low-grade ore is piled near the cut.

No. 24. Sulphur Gulch. (By Parker D. Trask and W. G. Pierce, November 1941.) The Sulphur Gulch deposit is located near the crest of the ridge 600 feet northeast of the north ore body in the Buckeye mine in sec. 2, T. 5 S., R. 5 E. (pl. 4). It was prospected in 1918 by E. H. Henderson, W. W. Breite, Herman Ludwig, and Frank Mason of San Francisco. Two cuts, an adit, and a winze were dug, but only a few tons of low-grade ore were encountered and the operations were abandoned.

No. 25. Summit Mine. (Condensed from original description in California Min. Bur. Rept. 11, p. 464, 1893.) A deposit called the Summit mine, 10 miles from the railroad in Stanislaus County, is reported to have produced 30 tons of ore, presumably before 1893. The property is located a short distance west of the Grayson mine (Stanislaus 10) probably in sec. 25, T. 6 S., R. 5 E.

No. 26. Sunbeam Manganese Mine. (By F. S. Hudson, November 9, 1918.) The Sunbeam mine is situated half a mile northwest of Mt. Oso in Stanislaus County. The operators are W. J. Wilson of Vernalis, J. J. Donahue and J. McFarland of Tuolumne. The main working place is a few feet due west of the corner of secs. 11, 12, 13, and 14, T. 5 S., R. 5 E. Another working is 200 feet due south of the same corner. At both these workings ore has been found on both sides of the section lines. The property in the odd numbered sections is leased from the Winship Estate, and that in sec. 14 is held as a mineral claim by the operators. The ore is hauled half a mile by sled, 1.5 miles by wagon, thence 17 miles by auto truck to Vernalis.

At the main working the ore occurs in association with a bed of massive chert, included in thin-bedded chert and shale. The strike is N. 60° E., and the dip 64° S. The ore has been followed for 40 feet along the strike and to a maximum depth of 20 feet by an open cut. The average thickness is 3 feet. A good face of ore is exposed at the mouth of the open cut which is 6 feet deep and 2.5 feet wide. This open cut has produced 150 tons of ore.

In the south working, 30 tons of good ore was found in association with a lens of massive chert, which dips 20° to 65° E. The massive chert pinches out 10 feet down the dip from the outcrop. No more ore is expected here. A few feet up the hill to the east is a prominent chert outcrop, stained with manganese. This outcrop seems well worth prospecting.

Work was commenced in July 1918. Since that time the operators have shipped two carloads to the Noble Electric Steel Company, and have two more ready to ship. The shipments averaged 45 percent manganese and 16 percent silica. According to Mr. Wilson it is impossible to sort the ore to better than 45 percent manganese and 16 percent silica. The Noble Electric Steel Company has recently advised him that it will only accept ore that is better than three parts manganese to one part silica.

No. 27. Thompson Brothers Prospect. (From files of U. S. Geological Survey.) The Thompson Brothers prospect is near the divide between Hospital and Ingram Canyons in sec. 25, T. 5 S., R. 5 E. It is owned by the Winship Estate and is reported to have produced 47 tons of ore in 1918 containing 47 percent manganese and 13 percent silica.

No. 28. Tip Top Mine (Seagrave, Ingram Canyon). By Parker D. Trask, December 2, 1942.) The Tip Top, or Seagrave mine as it was formerly called, is at the head of Grummett Creek about 1.5 miles east of the Buckeye mine (Stanislaus 4) in sec. 1, T. 5 S., R. 5 E. The mine was prospected by a few short adits in 1918 and several buildings and an ore bin were built, but no ore was shipped. The mine was developed at that time by the Western Rock Properties, of which M. C. Seagrave of San Francisco was general manager. Mining was renewed in 1941 by S. Johnson and M. A. Wright of Berkeley. They widened the road, repaired the bin, and installed an aerial tram. As of June 1, 1942, 119 tons containing 44 percent manganese had been shipped. Another ore body was opened north of the place from which this ore was obtained, and up to November 15, 1942, 315 tons from this ore body had been sold to the General Dry Battery Company.

The ore lies in the same belt of chert as is found at the Buckeye mine (Stanislaus 4) to the west (pl. 4). Three ore bodies are present. The two northern ones are 600 to 800 feet stratigraphically above the southern one. The southern body can be traced for 300 feet. Its average width is 2 feet, but the grade is moderately low, about 20 percent manganese. The two northern bodies are thicker and have better ore. They perhaps may be part of the same ore body separated by faulting, but they also may be two separate bodies 100 feet apart. The southern of the two northern bodies, that is, the middle ore body, can be traced for 200 feet and averages 4 feet in thickness. The ore is estimated to run 40 percent manganese. The northernmost ore body can definitely be traced for 135 feet and probably extends for another 200 feet. It averages about 2 feet wide on the surface, but at the west end where it is now being developed, it widens to 4 feet at a depth of 30 feet. The grade of the ore ranges from 30 to 40 percent.

TEHAMA COUNTY

No. 1. Cavaleri Prospect. (By R. R. Morse, July 28, 1918.) The Cavaleri prospect is 37 miles south-southwest of Red Bluff and 36 miles due west of Corning. The property is best reached by leaving the highway at Corning, following a good road for 30 miles to Paskenta, from which point 6 miles of very poor hill road leads to the Thurston ranch houses. The claims are located 0.3 mile up the ridge west of the houses, in the W½NW¼ sec. 14, T. 24 N., R. 7 W. The streams in this vicinity drain into Thomas Creek and the South Fork of Elder Creek. The original locator of the claims was a Mr. Thurston whose present address is unknown. The mineral located was supposed to be asbestos, occurring on one end of a claim which was later found to include outcrops of manganese-stained chert near the other end. A second claim was then located adjacent to this discovery. Subsequently the claims appear to have been abandoned, as assessment work ceased. Recently Mr. John Cavaleri of Tehama has relocated both claims, and excavated a small amount of low-grade manganese ore.

The prospect consists of an outcrop of red, green, and brown thin-bedded chert within which occurs a layer highly stained with black manganese oxide. The chert is entirely surrounded by serpentine and is in an area of Franciscan rocks which extends northward in a long narrow belt in western Tehama County. The chert outcrops are not over 30 feet in width or 50 in length.

The bed of manganese-stained chert and ore dips steeply into the hillside. Its footwall is a dense brecciated green chert. Above the ore bed, green and brown thin-bedded chert extends to the serpentine mass. The ore breaks from the walls readily, showing massive dense banded brown inner parts surrounded by selvedges of hard metallic appearing psilomelane which follow joint fractures and bedding planes. This dense flinty brown ore is distinguished with difficulty from the darker brown chert, except for its much higher specific gravity and the always present outer casings of psilomelane. It is apparently a dense siliceous brown carbonate ore similar to ores of this character found elsewhere in the Coast Ranges. The small size of the ore body, the siliceous character of the ore, and the difficulties of transportation, render this deposit of little commercial importance.

No. 2. Elva Mine. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 87, 1918.) The Elva mine is in sec. 20, T. 23 N., R. 7 W., 10 miles west of Paskenta, and 30 miles southwest of Corning, the nearest railroad station. The mine is on the south slope of Beauty View Peak at an altitude of 2,700 feet. Manganese oxides occur in lenses along a quartzose dike in a belt of serpentine. The manganiferous zone is extensive, but appears to contain a high percentage of silica. No ore has been produced, and the claim is worked for assessment only. C. S. Benner of Paskenta is the owner.

No. 3. Lockwood Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 88, 1918.) Lett Lockwood of Newville owns a claim in sec. 9, T. 23 N., R. 7 W., about 1 mile north of Toms Creek. The prospect is on the crest of a hill at an altitude of 2,650 feet. It is similar to the Manganese Peak deposit (Tehama 6). The summit of the hill is covered by broken chert and soil stained with manganese oxide from the outcrop. The ore body is 4 feet wide and in part is covered by debris. No development has been done.

No. 4. Logan Claim. (From files of U. S. Geological Survey, 1918.) The Logan claim is in sec. 17, T. 23 N., R. 7 W. E. P. Logan of Paskenta is the locator. The deposit is a belt of chert adjacent to a body of serpentine. Development consists of a small face 2 feet high and 2.5 feet wide, which exposes a lens of brown resinous manganese ore. A few veinlets of rhodochrosite are present. Little oxide ore is seen, the brown material being oxidized to a depth of only a few inches. On account of the lack of development work and the covering of soil, no estimate as to the amount of ore or the width of the lens could be made. These deposits are worthy of further development, as some good ore is exposed and there is a chance of finding one or more lenses of carbonate ore. The deposit is about 30 miles from the railroad and 2.5 miles from a good road.

No. 5. Manganese King Mine. (By Max D. Crittenden, Jr., August 28, 1942.) The Manganese King mine is on the east side of the Cold Fork of Cottonwood Creek near its headwaters, at an altitude of about 5,400 feet in the S½NE¼ sec. 8, T. 27 N., R. 9 W. It was originally located by Horace Gregory and Charles Moffitt of Red Bluff on September 8, 1939. The mine is reached by 3 miles of trail from a Forest Service road south of the Weston Ranch (Moffitt Ranch on the map). The property at present is leased to a Los Angeles company. There is no equipment at the mine, and development consists of some small pits and some hand work. No ore has been shipped.

The ore is found in a lens of thin-bedded chert 30 feet in thickness in a sequence of rocks that looks much like the Franciscan group, but the rocks are probably much older. Greenstone is found adjacent to the chert. The ore body is 100 feet in length and 1 foot to 6 feet in thickness. The average thickness is 3 feet. The ore minerals consist of alternate bands of granular bementite and manganese carbonate. The carbonate in places has been altered to black oxides but the depth of oxidation is scarcely more than 2 feet. The average grade is estimated to be 25 to 30 percent manganese and 25 percent silica. The relatively low grade and remoteness of this deposit combine to make it unattractive.

No. 6. Manganese Peak Group (Anti-Hitler, Anti-Mussolina). (By Ivan F. Wilson, July 22, 1942.) Manganese prospects described in Bulletin 76 [1] as the Manganese Peak group are located west of Paskenta in sec. 20, T. 23 N., R. 7 W. They are on the crest of the ridge between Bowers Creek and Thomas Creek and are reached by proceeding along the road from Paskenta to Covelo to a point 3 miles west of the junction with the road running south to Newville. At this place a road turns off to the northwest for 1 mile to a ranch labeled "Weston" on the Forest Service map of Trinity Forest. The prospects are located 2.5 miles west of this ranch. A trail follows a pipe line about a mile to Bowers Creek, but beyond this there is no well-defined trail. The prospects are about 35 miles west of Corning on the Southern Pacific Railroad.

Two claims were examined. One is located near the saddle northeast of Beauty View Butte (name given in Bulletin 76 [2] but not on Forest Service map) at an altitude of 2,100 feet. A claim notice was found which called this the "Anti-Hitler Lode," located by W. L. Leland of Chico on November 13, 1941. The long direction is 1,500 feet east-west. The notice gives the location as the west part of sec. 20, T. 20 N., R. 7 W. According to the Forest Service map it is closer to the north central part of sec. 20, and is in T. 23 N., not T. 20 N.

The second claim is on the top of Beauty View Butte, half a mile southwest of the first. The altitude indicated by aneroid is 2,750 feet, although the location is between the 2,400- and 2,600-foot contours on the Forest Service map. A claim notice found here calls this the "Anti-

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[1] California Min. Bur. Bull. 76, p. 88, 1918.
[2] Op. cit., p. 88-89.

Mussolina Lode'' (the spelling is that of the locator), located by George H. Bradbury of Chico on November 13, 1941. The long direction is 1,500 feet east-west. The notice gives the location as sec. 20, T. 20 N., R. 7 W., but actually it is in T. 23 N.

Development at the Anti-Hitler Lode consists of a cut 45 feet long running N. 65° W. along the top of the ridge. This cut exposes a bed of siliceous manganese ore or manganiferous chert about 5 feet wide. The attitude of the chert is not evident, but the beds are probably nearly vertical and they strike more or less parallel to the direction of the cut. The manganiferous body is bordered on the east by greenstone which in turn is followed by serpentine. To the west is 100 feet of black to green slaty shale and sandstone, bordered by serpentine. Serpentine is the dominant rock of the surrounding area.

The ore comprises manganese oxides—chiefly hard blue-black psilomelane occurring in massive dark green chert. This green chert makes up a large percentage of the material, the black oxides extending mostly along fractures and occurring as veinlets. On one specimen the black oxides were seen to occur as bands half an inch thick separated by beds of chert 2 to 3 inches thick. The ore is cut by quartz veinlets, and contains white and yellow patches of silica. Much of the material is manganiferous chert, and the best ore contains 20 to 30 percent manganese.

At the Anti-Mussolina prospect are two cuts about 12 feet long, which expose two beds of manganiferous ore, separated by 15 feet of white chert. The eastern bed has a maximum thickness of 9 feet, the western bed is 6 feet thick. The strike of the chert enclosing the eastern bed is N. 55° W., and the dip is 75° NE. The chert enclosing the western bed strikes N. 50° W., and dips 55° NE. The chert beds lens out into white chert to the southeast.

These beds are enclosed in thick-bedded white chert, which extends 50 feet to the southwest, beyond which is greenstone, in part vesicular. About 500 feet to the southwest is a belt of serpentine. The chert extends 100 feet northeast of the ore beds. It is also bordered by greenstone, which, along with the serpentine is the main rock encountered between this prospect and the Anti-Hitler Lode.

The greatest part of the manganiferous beds is manganiferous chert, and the better grade material is scattered through the chert irregularly. Much of the ore exhibits hard, blue-black psilomelane on the outside, but when broken reveals dark green to black cherty cores. A few small bands or veinlets of soft high-grade black oxides are also present. Some of the ore here may be richer than the ore in the Anti-Hitler Lode, but probably little material runs over 35 percent manganese. The run-of-mine ore probably contains 25 percent manganese. Some specimens of ore contain brown cherty spherules about 0.2 inch in diameter, and some possess a brown finely granular core which may be neotocite. A few specimens are cut by tiny pink to white veinlets of rhodochrosite.

Most of the material exposed at these prospects is not of shipping grade, and the possibilities of discovering better grade material do not seen favorable. It is said that the owners abandoned these prospects when assays revealed the low grade of the ore.

No. 7. Tehama Claims. (By Parker D. Trask, October 1942.) The Tehama claims are said to be in secs. 1, 2, 11, and 12, T. 26 N., R. 10 W., in the western part of Tehama County 7 miles from Saddle Camp and

47 miles from the railroad. The owners are George Allen of College City, and James A. Milham of Arbuckle. Development consists of one small cut. The deposit was not visited. Mr. Milham showed the writer a sample of the ore, which consisted of quartzite coated with manganese oxide and stained brown with iron oxides.

TRINITY COUNTY

No. 1. American Manganese Claims No. 1 and No. 2. (By Ivan F. Wilson, July 26, 1941.) American Manganese claims 1 and 2 are in the SW¼ sec. 23, T. 3 N., R. 7 E. They are located along the road to Hyampom 16.9 miles west of the Mayfork-Peanut road. The nearest railroad is 85 miles distant. Claim 1 was located by George I. Maker, and claim 2 by Gail G. Read, on February 28, 1941.

Development consists of a cut 3 or 4 feet deep along the road bank, exposing a body of massive green chert 10 feet thick containing manganese stains and coatings. The grade is estimated to be 3 to 5 percent manganese. The manganiferous green chert is interbedded with gray cherty shale and slaty shale, which has a thickness of at least 400 feet. The chert strikes N. 65° E., and dips 60° N. The manganiferous chert is exposed for a length of 6 feet, and no other rocks crop out in the immediate vicinity along the strike. The material exposed in the road cut is too low grade to be of economic value as a source of manganese.

No. 2. Apple Flat Prospect. (By Frank S. Simons and Max D. Crittenden, Jr., July 15, 1942.) The Apple Flat prospect is in the N½ sec. 13, T. 2 S., R. 7 E., 300 feet east of the Mad River road. It was located by Robert Hill and Ann Anderson on May 19, 1942. The claim extends 750 feet northwest and southeast from the discovery monument. The prospect is 67 miles from Alton, the shipping point. Manganese oxide ore is exposed in a series of shallow open cuts and in a few outcrops over a strike length of 235 feet. The strike ranges from N. 10°-40° W., and the dip from 20°-55° NE. Both walls of the ore body are shaly chert. The ore bed varies from 1.5 to 3 feet in thickness, averaging 2 feet. It consists roughly of two layers, 1 foot of ore on the hanging wall being high-grade oxide containing about 45 percent manganese, and 1 foot to 2 feet near the footwall being siliceous oxide ore containing about 25 percent manganese. The average grade is perhaps 30 percent manganese. Because of the siliceous nature of the ore, the prospect is not regarded as promising. No primary ore was found, but it probably is a manganiferous chert.

No. 3. Armstrong No. 1 Prospect. (By Parker D. Trask and Fred D. Trauger, July 30, 1941.) The Armstrong No. 1 claim is at an altitude of 3,500 feet on the east side of a peak, 1 mile southwest of the Double A Ranch on the southwest side of the Mad River, in the NE¼ sec. 19, T. 3 S., R. 8 E. The deposit was located by Robert Hill and H. J. Anderson of Ruth. The claim lies half a mile through brush from the nearest road, and is 70 miles from the railroad at Carlotta. No development work has been done. The ore consists of a 2-foot bed of low-grade siliceous ore estimated to contain about 15 percent manganese. This bed lies in a massive reef of white chert, which extends down the hill for a distance of more than 100 yards; but the grade of ore is so low that the deposit has little economic possibility.

No. 4. Armstrong No. 2 Prospect. (By Parker D. Trask and Fred D. Trauger, July 29, 1942.) The Armstrong No. 2 deposit is situated at an altitude of 3,500 feet on the south side of the Mad River about 1.5 miles south of the Double A. Ranch, in the SE¼ sec. 20, T. 3 S., R. 8 E. It was located by Robert Hill and H. J. Anderson in June 1941. It was leased to I. D. Budd and associates in the fall of 1941, who started to build a road to the deposit, but operations were stopped in the winter. In the spring of 1942 the property was taken over by the Victory Manganese Mines Company of Los Angeles. During the summer of 1942 this company made a road to within 0.3 mile of the deposit, intending to reach the deposit 100 feet below the upper outcrop so that the ore could be handled by gravity. The deposit is about 70 miles from the railroad at Carlotta. At the time the deposit was visited in July 1941, the two original locators were prospecting the mine and had opened two trenches about 4 feet in depth. Subsequently a shaft 20 feet deep was sunk.

The ore is found in a belt of red and white chert which forms the main backbone of the ridge on the south side of Mad River. The strike is northwest and the dip 60° to 80° N. The manganese is found in a belt of massive chert 200 feet thick. The ore bed is about 9 feet wide in the shaft but consists of two zones each about 3 feet thick, separated by a nearly barren middle zone. The ore can be traced along the strike for 40 feet. The ore on the north side of the mineralized zone is the richer and is estimated to average about 40 percent manganese. It consists of black oxides at the surface which give way to rhodochrosite, hausmannite, and bementite with depth. A few green stains of copper are seen. The south part of the ore zone consists mainly of manganiferous chert or neotocite, and is estimated to contain about 15 percent manganese. The presence of hausmannite in this ore enhances its value, but the proportion of hausmannite varies in different parts of the ore body. Much of the ore presumably is neotocite and manganese carbonate.

No. 5. Armstrong No. 3 Prospect. (By Frank S. Simons and Max D. Crittenden, Jr., July 16, 1942.) The Armstrong No. 3 prospect is in the SW¼ sec. 20, T. 3 S., R. 8 E., near the crest of the ridge between Armstrong and Van Horn Creeks, tributaries of the Mad River. The prospect was located by Robert Hill and Ann Anderson on August 29, 1941, and relocated on December 15, 1941. It is leased by the Victory Manganese Mines of Los Angeles. Harley A. Sill is the chief engineer of that company. The prospect is near the crest of a steep ridge formed by a belt of thin-bedded white, green, brown, and red shaly chert, which crops out prominently for several miles in a general northwest direction.

An open stope 65 feet long and 15 feet deep exposes a bed of manganese ore averaging 2 feet in thickness. The strike is N. 5° W., the dip 45° E. The bed is faulted off at the north end of the stope, and its continuation has not yet been found. About 140 feet N. 25° W. from the stope, an open cut exposes a badly faulted and folded bed of siliceous manganese oxide ore. The strike is N. 20° W., the dip 55° NE. This ore may be a continuation of the ore bed exposed in the stope, but no exposures confirm this.

The ore is a complex carbonate-neotocite material, only slightly oxidized, and probably averages 35 to 45 percent manganese and 20 to 30 percent silica. The ore shows evidence of hydrothermal alteration, and is cut by numerous thin veins of rhodochrosite. Small amounts of pyrite and either chrysocolla or malachite are present. Small amounts of high-grade manganese silicate or hausmannite containing perhaps 50 percent manganese occur. The ore bed is thin, and may not persist to any great depth. At the present depth the bed shows no indication of change in thickness. The lessors plan to drive a tunnel east from a point 250 feet below the present stope. The prospect is regarded as promising, though the probable silicate nature of the primary ore may present metallurgical difficulties. The prospect is 79 miles from Alton, the shipping point, and trucking costs will probably be in the neighborhood of $10 per ton.

No. 6. Arrowhead and Black Susan Claims. (By Parker D. Trask and A. F. Shride, June 1941.) The Arrowhead and Black Susan claims are situated at an altitude of about 4,000 feet, in the SW¼ sec. 30, T. 1 N., R. 8 E., about 1 mile from a road and 80 miles from Redding, the nearest rail point. The Arrowhead claim was taken out by Jules A. Hoelling on August 20, 1940, and the Black Susan claim by Sarah Hoelling on October 26, 1940. These claims trend northwest and the Arrowhead adjoins the Black Susan on the northwest. Development work consists of a few shallow pits. The ore lies in thin-bedded purplish chert, which is bounded on the south and east by greenstone. A representative sample contained 5.4 percent manganese. The chert everywhere is stained with thin films of manganese, and in a few places contains local segregations of manganiferous iron ore, some of which are as much as 10 feet in width and 20 feet in length. The ore in these segregations is estimated to contain 15 percent manganese and a like amount of iron. Most of the ore is found on the Arrowhead claim. Serpentine and greenstone occupy most of the Black Susan claim.

No. 7. Bald Steer Claim. (By E. F. Davis and A. O. Woodford, August 17, 1918.) The Bald Steer claim was located by A. G. Trinkle and G. E. Purcell of Covelo in the SE¼ sec. 17, T. 25 N., R. 12 W., near the Little Deer Prospects (Trinity 53 and 54). The deposit lies on a ridge formed of chert. In the northern part of the claim the chert strikes N. 20° E., and dips 30° to 35° W. In the southern part of the claim the strike changes abruptly to N. 50° E., and the dip becomes nearly vertical. The massive chert extends for 600 feet. At two places, about 150 feet apart, trenches have been cut across the ore zone. In the northern cut an ore body 5 feet thick is exposed. In the southern cut the ore is 8 feet thick. Along a part of the ore zone are outcrops of small ore bodies lying 15 feet stratigraphically above the main ore zone. The ore is black oxide. A general sample of the ore gave manganese, 28.7 percent, and silica, 45.6 percent. This deposit warrants further development.

No. 8. Bear Ridge Deposits. (By Charles R. Warren, August 23, 1941.) The Bear Ridge deposits are situated at an altitude of 5,000 feet in the SE¼ sec. 25 (?), T. 1 S., R. 5 E., about 3 miles by trail from the road to Lassie Lookout and 30 miles from Alder Point, the nearest railroad station. The claim was located by George A. Kniss and Lee Murphy on July 3, 1941. Little development has been done. The deposits consist of a body of manganiferous chert rich in iron, 220 feet in length and 45 feet in maximum thickness. The strike is east and the dip is vertical. The chert is surrounded by serpentine on the east, north, and west, and perhaps also on the south, but exposures are poor on the south side and the relationships are obscure. The chert has been altered near the contact with the serpentine. Though the tonnage of manganiferous chert is large, probably in excess of 50,000 tons, the grade probably is less than 10 percent. The poorness of the grade and high iron content make the deposit unpromising.

No. 9. Bertha Deposits (Yolla Bolly). (By Parker D. Trask, October 1942.) A series of manganese deposits occurs on the south side of North Yolla Bolly Mountain on the top of a west-trending ridge at an altitude of about 6,000 feet in the SE¼ sec. 32, and SW¼ sec. 33, T. 27 N., R. 10 W. These deposits are known by several names. John Mosier of Hayfork is said to have located three groups of claims on these deposits in June 1940. These groups are known as the Bertha (Trinity 9), the Dahrman (Trinity 36), and the Emma (Trinity 39). The Emma is the westernmost of these groups, the Bertha the middle group, and the Dahrman the easternmost. In all, 14 claims are said to have been located by Mr. Mosier and his associates. The deposits are also reported to have been located by A. M. Knapp, Lee Hillstead, and Carl Hillstead in June 1941, under the name of Lonesome Pine, Black Diamond, Black Pearl, Reliance, and Superior claims. Several claims are said to have been taken out under each of these names, the claims running from west to east in the order given above. Under date of June 13, 1941, I. D. Budd also staked claims in this region.

The deposits seem to have been leased to several different people and organizations, one of which is Consolidated Minerals, Inc., of Los Angeles. J. W. White, George Wilmot, and a Mr. Moon are said to be principals in this company. In the summer of 1942, Mr. Mosier is reported to have given a lease to a Mr. Scales of San Francisco.

The deposits were first worked during World War I, at which time they are said to have been located by the same John Mosier who relocated them in 1940. At that time two shafts, 15 feet in depth, were sunk but the war ended before any ore was shipped. They then lay idle until 1935 when an option is said to have been given to Mr. Knapp, who, as mentioned above, is reported to have located the deposits in 1941. No work however was done in 1935, and they lay idle until the summer of 1941 when Mr. Knapp and his associates undertook development.

The deposits are located in rugged country, at least 12 or 15 miles by any practicable route from an existing road. They are reached by trail from Saddle Camp to the east, Tedoc to the northeast, and White Rock to the north. The nearest route to a railroad is by way of Saddle Camp, but the distance even by this route is 60 miles. The cost of constructing a road to the deposits would be high, as much bedrock would have to be blasted. Winter snows can be expected in the region from October 15 to June 1; consequently the maintenance of a road and mining operations during the winter would be difficult.

The deposits, despite their remoteness, offer some promise. They consist of manganiferous chert and rhodochrosite in a belt of thin-bedded and massive chert 500 feet in thickness, and at least 1 mile in length. The strike is N. 70° W., and the dip 30° NE. The chert is succeeded on each side by sandstone and shale of the Franciscan group, and probably is part of the same belt of chert in which the Bonanza claims (Trinity 22) are found 10 miles to the northwest. The beds are followed by schist and phyllite for 5,000 feet across the strike to the northeast. This belt of metamorphic rocks continues uninterruptedly in a northwesterly direction for at least 50 miles, and separates the Franciscan rocks on the west from the supposedly older rocks to the east.

The manganese is found in two zones, one of which attains a maximum thickness of 12 feet and the other a thickness of 2 feet. In places the chert consists of alternating bands of shale and chert, and some of the chert bands contain rhombs or spherules of carbonate. The ore zones cannot be traced continuously for more than 300 feet along the strike, and they vary considerably in width where visible. The average width of the main zone is 4 feet. Relatively little oxide is present, and in places the ore grades downward into primary rhodochrosite and manganiferous chert or bementite within 5 feet of the surface of the ground. The grade of the ore is estimated to average about 20 percent manganese, but in places is as high as 35 percent.

No. 10. Big Boy Deposit. (By Charles R. Warren, August 26, 1941.) The Big Boy deposit is situated at an altitude of 2,000 feet in the SE¼SW¼ sec. 17, T. 3 S., R. 6 E., half a mile from a road and 6 miles from Alder Point, the nearest rail point. It is on land owned by Arthur Crossman. No development has been done. The ore body lies in green and white chert, which strikes N. 75° W., and dips 65° to 85° N. The deposit runs diagonally up the hill for 75 feet. The average width is 4 feet. The ore consists of stains on chert and the grade is under 3 percent manganese.

No. 11. Big Buck. (By Ivan F. Wilson, July 22, 1941.) The Big Buck claim is in the SE¼ sec. 4, T. 1 S., R. 8 E., on the Long Gulch trail, half a mile north of the Forest Glen-Hayfork road, and 1,600 feet west of The Manganese claim (Trinity 90). It was located by Edwin Lowry on February 24, 1941. The nearest railroad is 70 miles distant. This claim contains an outcrop of manganese chert 20 feet wide and 30 feet long. The chert strikes N. 40° W., and dips 15° SW. A trench 3 feet deep has been opened around the ore body to the northwest and northeast. This cut exposes cherty shale, and also some greenstone on the northwest. Serpentine crops out in a gully on the southeast. No rock is exposed on the southwest.

The manganese is in the form of incompletely oxidized bementite and perhaps neotocite. The bementite is partly coarsely crystalline, in tabular crystals up to half an inch in diameter. These were determined microscopically by F. S. Simons. The crystals have a thin coating of black oxide. The average grade of the manganese chert is 10 percent or less. Perhaps 500 tons of this type of ore is present.

No. 12. Big Horn No. 1 Prospect. (By Parker D. Trask, April 8, 1942.) The Big Horn No. 1 is located at an altitude of about 3,000 feet on the William P. White Estate, 0.3 mile from a road and 10 miles from Alder Point in the SE¼ sec. 9, T. 4 S., R. 6 E. It is under lease to Rae F. Helmke. The deposit lies 0.7 mile southwest of Schoolhouse No. 1. It is on the north side of a steep slope in which the bedrock consists of sheared chert. The deposit is 1 foot wide and is exposed for a distance of 5 feet on the side of a cliff. The ore consists of manganiferous chert and rhodochrosite. The grade is estimated to be less than 10 percent manganese.

No. 13. Big Horn No. 2 Prospect. (From files of U. S. Geological Survey, 1942.) The Big Horn No. 2 prospect lies near the Big Horn No. 1 prospect (Trinity 12) in sec. 9, T. 4 S., R. 6 E. The ore body is said to be 4 feet thick but relatively low in grade. The primary mineral is reported to be rhodochrosite.

No. 14. Big Rock Claim. (By Ivan F. Wilson, July 25, 1941.) The Big Rock claim is in the SW¼ sec. 12, T. 3 N., R. 6 E., on the Eltapom trail. It is reached by proceeding north from Hyampom Post Office for 2.5 miles, and turning west 0.3 mile to the Mosher's Ranch. The prospect is then reached by trail along the west side of a ridge half a mile west of Mosher's Ranch. The nearest railroad is 90 miles away. The claim was located by William Rowland and Emil V. Lehmann, Jr., on August 29, 1940. The ore consists of thin films of manganese oxide or chert. About 6 cuts have been dug into the hill slope, but no manganese was seen except in the form of stains. An assay ran 0.81 percent manganese. The chert is surrounded by greenstone and serpentine.

No. 15. Black Bird Claim. (By W. G. Pierce, August 8, 1941.) The Black Bird claim is near the town of Ruth, in the N½ (?) sec. 4, T. 2 S., R. 7 E. This deposit was located by J. N. Hutchens on August 3, 1941. The deposit was not visited because of the low grade of the samples from it that were seen. They consisted of manganese stains on chert similar to the other deposits visited in the general vicinity (Trinity 16 and 25).

No. 16. Black Hawk Claim. (By W. G. Pierce, August 8, 1941.) The Black Hawk claim is in NW¼ sec. 3, T. 2 S., R. 7 E., 1 mile northwest of Ruth, and 1 mile from the road. It was located by J. N. Hutchens on August 1, 1941. The deposit consists of manganese stains in chert. No commercial ore was seen.

No. 17. Black Hawk Claim. (By Ivan F. Wilson, July 29, 1941.) The Black Hawk claim is 600 feet north of the Jewett claim, in the NW¼ sec. 32, T. 29 N., R. 11 W. It is described in the report on the Jewett claim (Trinity 48). The claim was located July 1, 1941, by George W. Silvester. The property contains a pit in greenstone 6 by 2 feet, and 2 feet deep. The greenstone contains a few manganese oxide films along fractures. The grade is probably less than 1 percent manganese.

No. 18. Black Oak Mine. (By Parker D. Trask and A. F. Shride, November 22, 1942.) The Black Oak mine is located at an altitude of 4,000 feet in the NW¼ sec. 5, T. 3 S., R. 6 E., on a claim located by A. C. Crossman and T. K. Tyree in 1940 or early in 1941. During World War I, 25 tons was piled on a dump near the mine, but no ore was actually shipped. The deposit at that time was in the name of Pat and Mary Cox. It is located on a ranch road, about 10 miles from Alder Point, the nearest rail point.

The deposit lies in a belt of thin-bedded red chert which extends in a northwesterly direction for more than 700 feet. The ore body itself is 3 to 5 feet wide and dips vertically. When visited in 1941, the ore body could be traced for 40 feet. The ore consists of siliceous oxide, which seemingly becomes poorer in grade with depth. No rhodochrosite or bementite was seen. The deposit was worked during the spring of 1942 by A. Z. Crossman (brother of A. C. Crossman), and after much sorting, a car was shipped, but the grade failed to meet Metals Reserve Company specifications. A large cut was made along the ore body in the summer of 1942 and all the ore mined out. The mine was then abandoned.

No. 19. Black Rock Claim. (By Ivan F. Wilson, July 25, 1941.) The Black Rock claim is in the SW¼ sec. 12, T. 3 N., R. 6 E. It is 200 yards south of the Big Rock claim(Trinity 14). The claim was located August 12, 1940, by Lawrence Leckrone. An area of manganese ore about 12 feet in diameter lies in a body of white chert. The ore occurs as black coatings on light-colored chert, and as compact masses of black oxide. Some patches of pink rhodonite were seen, and this is evidently the primary mineral from which the oxide was derived. Some of the oxide ore is fairly high grade. An assay of one sample averaged 46.35 percent manganese.

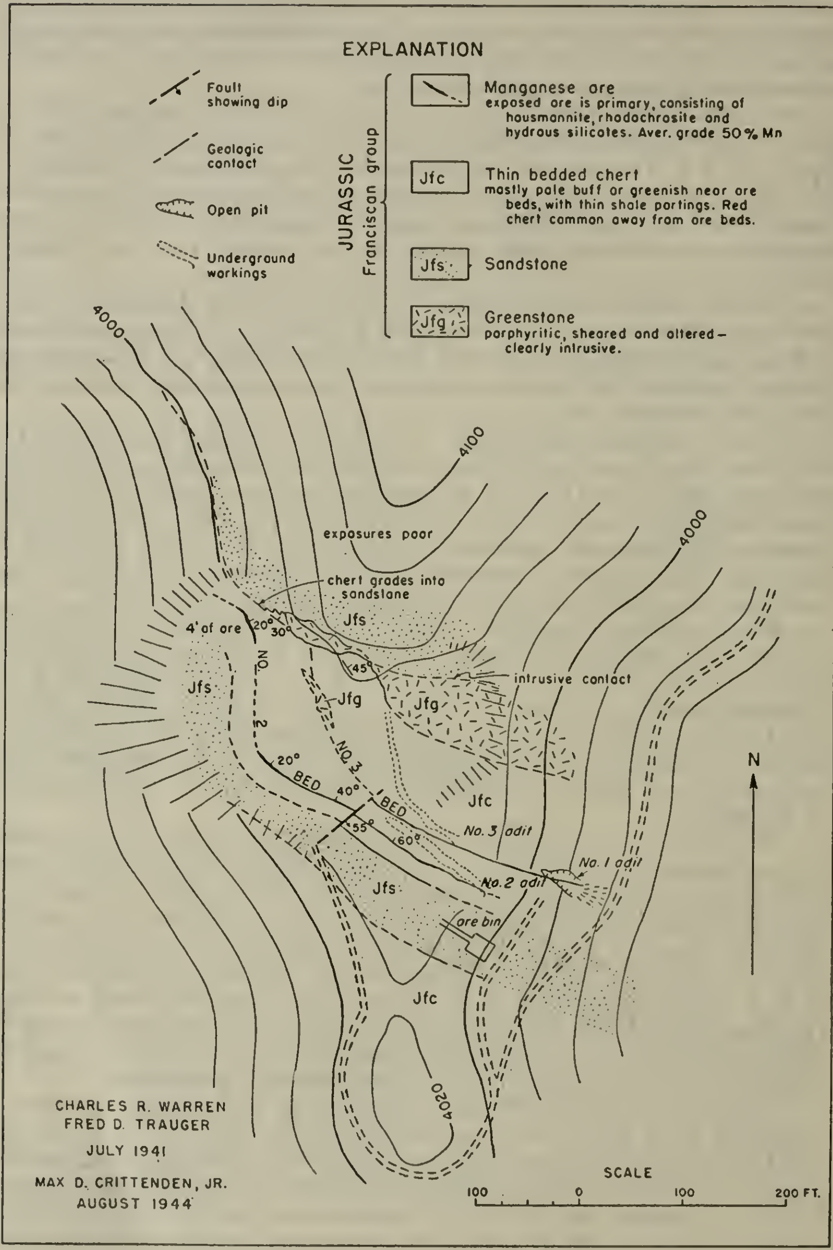

EXPLANATION
Fault showing dip
Geologic contact
Open pit
Underground workings
JURASSIC
Franciscan group
Manganese ore
exposed ore is primary, consisting of hausmannite, rhodochrosite and hydrous silicates. Aver. grade 50% Mn
Jfc
Thin bedded chert
mostly pale buff or greenish near ore beds, with thin shale partings. Red chert common away from ore beds.
Jfs
Sandstone
Jfg
Greenstone
porphyritic, sheared and altered – clearly intrusive.
4000
4100
4000
4020
exposures poor
chert grades into sandstone
4' of ore
20°
30°
45°
Jfs
Jfg
Jfg
intrusive contact
NO. 2
20°
BED
NO. 3
40°
BED
55°
60°
Jfc
No. 3 adit
No. 1 adit
No. 2 adit
Jfs
ore bin
Jfc
N
CHARLES R. WARREN
FRED D. TRAUGER
JULY 1941
MAX D. CRITTENDEN, JR.
AUGUST 1944
SCALE
100
0
100
200 FT.

FIGURE 9. Geologic and topographic map of the Blue Jay mine, Trinity County, California.

The white chert which encloses the ore strikes N. 40° E., and dips 55° N. The chert is completely surrounded by serpentine, and is regarded as a roof pendant in serpentine. About 50 tons of ore are reasonably expectable from the present exposures. Although part of this runs 45 percent manganese, the average is probably closer to 15 percent. The possibilities are slight for any great reserves.

No. 20. Blue Jay Mine (Blue Bird Claim). (By Parker D. Trask and Fred D. Trauger, November 1, 1942.) The Blue Jay mine is one of the best deposits of manganese discovered in California during World War II. It was found by J. M. McKnight and F. A. Stockel in May 1941. They took out two claims, one the Blue Jay under the names of J. M. McKnight and A. M. McKnight; and the other, the Blue Bird, under the name of W. A. Stockel. The claims are situated in NW¼ sec. 17, T. 26 N., R. 12 W., at an altitude of 4,200 feet, on the west side of the divide between the Mad and Eel Rivers.

The deposits were leased in the summer of 1941 to I. D. Budd and associates, who started to build a road to the deposits but soon abandoned their efforts, presumably for lack of funds. The deposits were taken over by James I. Scott Company in the spring of 1942. A road 4 miles in length was built from the end of the road on the south fork of the Mad River, and the first ore was shipped early in the summer of 1942. By November 30, 1942, 1,500 tons of ore running between 50 and 55 percent manganese, and 8 to 10 percent silica had been shipped to the Metals Reserve Company. The ore is shipped 80 miles by truck to Alton; one round trip per day per truck. The deposits were opened up on the south end, and as of November 1, 1942, had been worked for a distance of some 200 feet, and to a maximum depth of 100 feet in two ore bodies, each averaging 3 to 4 feet in thickness. They lie in thin-bedded white chert which strikes northwest and dips 50° NE.

In August 1941 a plane table map of the deposits was made by Charles R. Warren and Frederick D. Trauger of the U. S. Geological Survey (fig. 9). This map was subsequently brought up to date by Frank S. Simons in 1942 and by Max D. Crittenden in 1944, after mining operations had begun. When the deposits were first discovered, the ore body could be traced for 300 feet more or less continuously along the strike, and one exposure of ore to the northwest in the projection of the strike was found at a distance of 150 feet beyond the last outcrop of the main ore body. The mining operations have shown that the ore bodies extend for at least 150 feet farther to the southeast than was apparent before they were developed. The southeast limit of the deposits has not been determined, for the ore body still continues at the southeastern end. At the place where the ore is being mined at present the ore bodies are continuous and are not materially offset by faults, but to the northwest small faults displace the ore, and at the northwest end 200 feet beyond the present workings the ore body is faulted off and its continuation has not been found, except for the one outcrop 150 feet farther to the northwest. The upper ore body can be traced for only 200 feet, whereas the lower one is exposed more or less continuously for 400 feet.

The ore consists of high-grade oxides at the surface. These contain from 50 to 60 percent manganese. They give way at depth to a mixture of hausmannite, carbonate, and bementite, and in places carry a little native copper. This copper is found mainly in calcite veins which cut most of the other minerals. Chemicals analyses of the primary ore give from 50 to 55 percent manganese, 6 to 10 percent silica, and 3 to 9 percent carbon dioxide. The proportion of the primary minerals varies considerably, but in places the ore seems to contain hausmannite. The hausmannite is dark reddish-brown and is very fine-grained, but in thin section shows a triangular and diamond shaped pattern. X-ray patterns give typical hausmannite lines. The red color of the hausmannite induced the operators to throw away considerable ore in the early period of mining, and one dump was found to have an average content of 40 percent manganese.

Blue Jay Mine. (By Max D. Crittenden, Jr., August 1944.) The Blue Jay mine was operated by James I. Scott to October 1943, and up to that time had produced 2,900 tons averaging 50 percent manganese. It was then taken over by J. P. Warren who till August 1944 had produced 1,745 tons averaging 51 percent manganese, 1.35 percent iron, and 12 percent silica. The outcrop of the ore beds has been stripped by means of a bulldozer to a depth of 25 feet at the south end, and 35 feet at the north end. The ore was mined selectively. Earlier development consisted of three principal adits begun on the eastern slope of the ridge. These were abandoned partly because of the difficulty of following and locating the faulted segments of the ore beds.

Manganese ore occurs at the Blue Jay mine in two beds, about 15 feet apart, enclosed in thin-bedded chert of the Franciscan group. On the eastern slope of the ridge the average strike of the beds is N. 55° W., and the dip is 60°-75° NE. This general trend continues west to about the crest of the ridge where a fault striking N. 50° E., and dipping 55° SE. displaces the beds slightly, and produces a change in attitude. West of the fault, the beds strike N. 20°-30° W., and dip 20°-30° NE. Only one fault is exposed, but others probably exist as is indicated by irregularities and apparent discontinuities in the ore.

The segments of the ore beds west of the fault are not exposed. However, the No. 2 bed was worked for a distance of 125 feet from the fault in an open trench later filled. This segment appears to be the same bed that was exposed in the northwest edge of the pit in August 1944 (fig. 9). The greenstone exposed in the pit is a relatively thin body which was apparently injected approximately along the contact of the chert and sandstone, exposed in the north edge of the pit. Northwest of the greenstone, the chert merges along the strike with sandstone. The chert has been bleached white in places along the greenstone contact.

The ore from the open pit is largely primary, as surface oxidation usually forms only a coating of black oxides 1 inch to 2 inches thick. The primary ore is mostly reddish-brown hausmannite, cut by veinlets of rhodochrosite, or hydrous silicates. Quartz veins were observed, which carry some chalcocite, and which have formed inesite by reaction with the other manganese minerals. Secondary copper minerals include native copper, cuprite, and malachite.

No. 21. Blue Lizard Prospect. (From files of U. S. Geological Survey, 1918.) The Blue Lizard prospect is on the White Ranch, 0.3 mile from the road, 10 miles east of Alder Point, near the Big Horn deposits (Trinity 12 and 13) in sec. 9, T. 4 S., R. 6 E. The prospect is leased to Rae F. Helmke of Alder Point, but has produced no ore. The ore body is exposed for a quarter of a mile. It varies in width but seemingly is of low grade. Representative assays give manganese, 30 percent; silica, 25 percent; and a relatively high iron content.

No. 22. Bonanza Claims. (By A. F. Shride and S. C. Creasey, August 1941.) The Bonanza claims are in the S½ sec. 3, T. 27 N., R. 12 W. Two claims, the Bonanza and Bonanza No. 1, were located on July 4, 1941, by F. A. Stockel and J. M. McKnight. The claims extend 1,500 feet to the north, and 600 feet to the east. They have a common boundary. The Bonanza claim is west of the Bonanza No. 1. The claims are 3.5 miles by poor trail from the nearest road, and about 600 feet higher than the road. The last 2,500 feet of trail rises 400 feet. The trail takes off from the road to the Three Forks of the Mad River, which is approximately 14 miles by road southeast of the town of Ruth. The Hoaglin Quadrangle covers all the above mentioned roads and reference points.

Before the ore can be shipped, 3.5 miles of road must be built. The last 2,500 feet would be hard to construct. Part of this distance would either go up the creek bottom or be blasted from solid rock. The first 3 miles could be made with bulldozers. Numerous creek crossings would be necessary along any proposed route. From Three Forks it is 80 miles to Carlotta.

The general strike in the area is northwest and the dip is northeast with varying degrees of steepness, ranging from about 30° to nearly vertical. The rocks are of the Franciscan group. The sandstone is a medium-grained rock containing quartz, feldspar, chert, shale, and serpentine (?) fragments. It lies on the southwest side of the chert and greenstone and dips under them toward the northeast at an angle of 50°. The greenstone occurs within the chert as irregular potato-shaped patches with the long axes parallel to the strike of the chert. The distribution of the greenstone suggests that it parallels the strike of the chert. Three patches of greenstone are present. They may represent the same igneous body, which could be either a flow or shallow sill. The original composition and texture of the rock has been destroyed during the alteration to a greenstone. However, the hardness and color of the rock suggest it was at least as basic as an andesite, if not a basalt.

Three separate landslides are recognizable on the two claims. The rubble is mostly chert with some ore scattered throughout the lowest slide. The lowest slide overlies the sandstone, which shows that the slide moved in a southwesterly direction from the chert member, partly covering the sandstone-chert contact and coming to rest in the creek bottom. Subsequently the creek has cut through the slide leaving it exposed on both sides of the stream.

Manganese ore is found in two exposures on the Bonanza No. 1 claim as well as in irregular blocks in the landslides and along the creek bottom. All the ore seen on both claims is oxide. The western bedrock exposure of the ore is the best on the claims. It is 70 feet long and at least 12 feet thick in the thickest part. The footwall is unexposed along the entire length. The bed lies conformably in the chert. Three grades of ore were recognized in this bed. The bulk of the ore was estimated to contain around 30 percent manganese. For a distance of 40 feet along the footwall was a band of high-grade ore which contains about 40 percent manganese. The remainder of the ore is highly siliceous and contains less than 30 percent manganese. The ore body 200 feet east of the main manganese outcrop is 3.5 feet thick and is conformable with the chert. It contains about 30 percent manganese.

No. 23. Briggs Deposits. (By Charles R. Warren, August 25, 1941.) The Briggs deposits are at an altitude of 3,000 feet, 1 mile north of Zenia in the W½ sec. 10, T. 3 S., R. 6 E. The deposits are half a mile from a road and 15 miles from Alder Point, the nearest rail point. They are upon patented land owned by Dean Briggs. Development consists of a pit, which presumably dates from the last war. The deposit consists of manganese stains on red chert, and is of little value.

No. 24. Broken Hammer Prospect. (From files of U. S. Geological Survey, 1942.) The Broken Hammer prospect is on the White Ranch 0.3 mile from the road, 10 miles east of Alder Point, in sec. 10, T. 4 S., R. 6 E. It is leased to Rae F. Helmke of Alder Point. The ore zone is said to be 7 feet thick, but is low grade and siliceous.

No. 25. Brown Dog Claim. (By W. G. Pierce, August 8, 1941.) The Brown Dog claim is in the SW¼ sec. 34, T. 1 S., R. 7 E., on the north side of the Mad River 3 miles northwest of Ruth. The claim was located by J. N. Hutchens in April 1941. The deposit consists of manganiferous chert striking N. 30° W., and dipping 35° NE. A representative sample contained 5.28 percent manganese. In one place the chert seemingly contains a little carbonate and bementite, but not sufficient to make the deposit promising, as the deposit passes into chert within 2 feet.

Nos. 26 and 27. Bucking Camp Deposits No. 1 and No. 2. (By Parker D. Trask and Frank S. Simons, April 7, 1942.) The Bucking Camp deposits are located on the Rohrbaugh Ranch in sec. 32, T. 3 S., R. 6 E., at an altitude of 2,500 feet. Deposit No. 1 is in the NW¼ and No. 2 in the NE¼ of the section. No. 1 is 1 mile from the Alder Point road and No. 2 is 1.5 miles from the road. The distance to Alder Point is 8 miles. Bucking Camp No. 2 was not visited but the ore body is said to be low in grade and small in size. In the Bucking Camp No. 1 deposit the ore bed is exposed at intervals for 125 feet and has an average width of 2 feet. Presumably it is continuous throughout the entire interval, but without additional excavation this inference cannot be verified. The ore bed is in red chert and strikes N. 75° W., and dips 40° NE. The grade is variable. At the surface the ore consists of oxide but at depth it probably gives way to rhodochrosite, though none was seen. The average grade is estimated to be 25 percent manganese. The thinness of the ore body, the comparatively low grade and the uncertainty of linear extent combine to make this deposit unattractive.

Nos. 28 and 29. Carr and Carrie Claims. (By Parker D. Trask, June 1941.) The Carr and Carrie claims and the adjoining Louella claim (Trinity 57) are located in the SW¼ sec. 30, T. 31 N., R. 12 W., about 8 miles west of Hay Fork on the south side of the Tule Creek road to Indian Valley. The deposits are 0.2 mile from the road and 58 miles from the railroad at Redding. The three claims were located in the fall of 1940 by W. B. Carr, E. E. McFadden, and Thomas M. Porter. They were leased in the fall of 1940 to William Vance and associates. At the time the deposits were visited in June 1941, the claims had not been developed. The manganese is in a belt of thin-bedded purplish manganiferous chert 400 feet wide and at least 800 feet in length. The strike is northeast and the dip is nearly vertical. The chert is cut off by greenstone on the two sides and seemingly is a roof pendant in a basic plutonic rock. The manganese content is nowhere more than 20 percent, and the general average is probably under 10 percent. The manganese is concentrated in three places; two at the northeast end, 300 feet apart across the strike, and the other 600 feet to the south across a ravine. The northeast deposit is on the Louella claim, the southeast one is on the Carr claim, and the southwest one is the Carrie claim. The Carrie deposit is lower grade than the others. It does not have much ore containing over 5 percent manganese, and it lies adjacent to greenstone.

No. 30. Cedar Springs Claim. (By Parker D. Trask and A. F. Shride, June 1941.) The Cedar Springs claim is 0.3 mile southeast of the Black Susan claim (Trinity 6) in the NW¼ sec. 31, T. 1 N., R. 8 E. It was located by J. W. Patton of Hayford. It lies in thin-bedded chert in the projection of the chert in the Arrowhead and Susan claim (Trinity 6), but is separated from that body of chert by greenstone. The ore is found in segregations in the chert, but the quantity is even smaller than in the Arowhead and Susan claims. The grade is of the order of 15 percent manganese.

No. 31. Claim 23. (By Parker D. Trask, July 1941.) A pit was found about 50 feet north of the road to Limedyke, 150 feet due east of the section marker between secs. 29 and 30, T. 1 N., R. 8 E., about 13 miles west of Hayfork and 80 miles from Redding. Another pit was found 150 feet to the east. The pits are 3 feet deep, and expose manganiferous chert in thin-bedded red chert. The grade of ore is less than 10 percent manganese. This claim has been designated Claim 23. No claim notice was found. The location of this deposit is uncertain, because the position of the section markers made by the Forest Service in their timber cruising operations does not correspond with those given on the Hoaglin topographic map made by the U. S. Geological Survey.

Nos. 32 and 33. Coldwater No. 1 and No. 2 Deposits. (By Parker D. Trask, April 7, 1942.) The Coldwater No. 1 and No. 2 deposits are in the NE¼ sec. 5, T. 4 S., R. 6 E., at an altitude of about 3,000 feet. They are on deeded land in the William White Estate. Coldwater No. 1 is 50 yards below the road, and No. 2 about a quarter of a mile below the road. Both are 10 miles from Alder Point, the nearest rail point. About 50 tons was mined in 1942 from each deposit by Rae F. Helmke of Alder Point. The ore consists of blocks of high-grade manganese oxide lying in landslide debris. Mining is by bulldozing and hand sorting. No ore has yet been found in place. The debris associated with the ore consists principally of chert. The source of the deposits higher on the mountain has not yet been found. Much of the ore is of high grade, and the average is estimated to be over 45 percent manganese. The estimation of reserves is hazardous because of the uncertainty as to the distribution of ore in the landslide debris. About 25 tons is estimated to be in sight at No. 1, and 10 tons at No. 2.

No. 34. Corner No. 1 and No. 2 Prospects. (From files of U. S. Geological Survey, 1942.) The Corner No. 1 and No. 2 prospects are located upon the White Ranch half a mile from the road, 10 miles east of Alder Point in sec. 5, T. 4 S., R. 6 E. They are leased to Rae F. Helmke of Alder Point. The soil is covered with float of manganese oxide similar to the occurrence of manganese in the Coldwater deposits (Trinity 32 and 33) which are nearby in the same section.

No. 35. Coyote Claim. (By Charles R. Warren, August 25, 1941.) The Coyote mining claim is in the SW¼ sec. 13, T. 3 S., R. 6 E., at an altitude of 3,800 feet on the road 0.9 mile south of Zenia, and 8 miles from Alder Point, the nearest rail point. The claim was located May 26, 1941, by George A. Kniss and Lee Murphy. One pit now about 8 feet deep was dug during the last war. The deposits consist of manganese stains in a chert zone 5 feet wide. The strike is N. 35° W., and the dip 40° SW. The chert is reported to give way to sandstone below the present bottom of the pit. The grade of manganese is estimated to be less than 5 percent.

No. 36. Dahrman Group. (By Parker D. Trask, October 1942.) The Dahrman group of claims is the easternmost of the three groups of claims located by John Mosier on North Yolla Bolly Mountain in secs. 32 and 33, T. 27 N., R. 10 W. For details see the description of the Bertha group of claims (Trinity 9).

No. 37. Double-A Prospect. (By Frank S. Simons and Max D. Crittenden, Jr., July 16, 1942.) The Double-A prospect is in the center of sec. 16, T. 3 S., R. 8 E., on the west side of Horse Ridge near the head of the first large canyon northwest of Barry Creek, a tributary of Mad River. It is about 1 mile northeast of the Mad River road and 74 miles from the railroad at Alton, the nearest rail point. At present the prospect is reached by 1 mile of trail. It was located by Robert Hill and Ann Anderson on January 6, 1942, and is leased by the Victory Manganese Mines of Los Angeles.

The manganese ore occurs in thin-bedded shaly red chert, striking north to N. 30° W., and dipping from 35° to 55° E. Two open cuts have been made. The south cut exposes a bed of ore ranging from a feather edge to 1 foot in thickness along a strike length of 8 feet. This exposure appears to be at the top of an ore lens. A small pod of ore occurs 4 feet stratigraphically below this lens. In the north cut, 30 feet from the south cut, an ore bed up to 2 feet in thickness is exposed. This bed appears to be offset about 15 feet horizontally west of the south bed, and a fault is probably the cause, although the bed may be sharply folded and not exposed. Twenty feet farther north a small cut has exposed a small amount of manganese ore which is probably a continuation of the bed in the north cut. The ore bed may have a length of 100 feet, and a maximum thickness of 2 feet.

The ore is mostly a reddish-black, very hard and heavy material similar to that at the Blue Jay mine (Trinity 20) farther south. It is thought to be a mixture of hausmannite and silica, and probably contains 40 percent manganese. A small amount of manganese carbonate replaces the hausmannite. Both these minerals are cut by later veins of rhodochrosite and quartz. A few green copper minerals, but no native copper, were seen. Very little black oxide ore was found, the primary minerals occurring within a few inches of the surface.

Double-A Prospect. (By Max D. Crittenden, Jr., August 25, 1944.) The Double-A mine was leased in 1944 to J. B. Girdner who produced 87 long tons of ore averaging 39 percent manganese. A road has been built within 150 feet of the property and an ore bin and chutes have been installed. Manganese ore is exposed in three small pits on a steep hillside. It is enclosed by chert of the Franciscan group, striking generally north, and dipping east, but the beds are so folded and faulted that it is uncertain whether all the exposures constitute a single lens.

The ore is a banded mixture of the following minerals: (1) rhodochrosite, coarse-grained, commonly spherulitic, yellowish or buff-colored; (2) hausmannite (?), reddish brown; (3) manganiferous chert, brown, semi-waxy; (4) bementite, yellowish, scattered flecks and veinlets. The rhodochrosite in places is intimately mixed with manganiferous chert and quartz. The average grade of the ore is about 35 percent manganese, but a product averaging 40 percent can be obtained by careful sorting.

A thin section of spherulitic rhodochrosite shows radial aggregates 1 millimeter to 4 millimeters in diameter with some pale tan bementite in the interstices, and cut by numerous small veins of granular quartz. The latest mineral is a bright yellow, felted or radiating fibrous serpentine-like mineral that has developed within and around the rhodochrosite spherulites, and along the grain boundaries of the quartz veins. It forms radiating needles and sheafs that extend out into the quartz or bementite that it replaces. This mineral is uniaxial negative, or biaxial negative, with a low 2V, showing strong cleavage, parallel extinction, and positive elongation. The birefringence is about 0.010, and the indices 1.70 to 1.71.

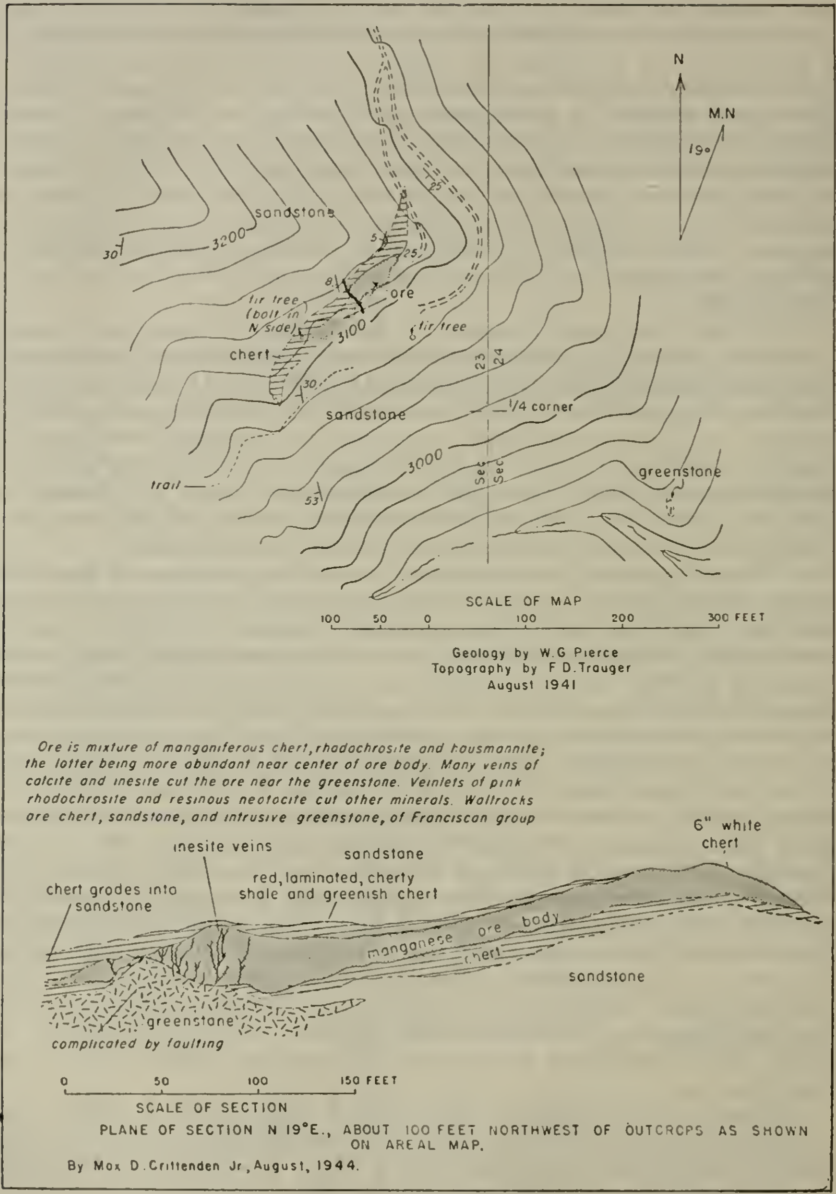
No. 38. Dry Lake Prospect. (By Parker D. Trask, July 1941.) The Dry Lake claim is situated on the crest of Peak 3453, 2 miles south of Peanut in the SW¼ sec. 13, T. 30 N., R. 12 W. It was located in August 1940 by Clarence Patton of Peanut. Development consists of four trenches up to 10 feet in depth. No ore has been shipped. The deposit is 1 mile by trail from the road up Salt Creek, and 70 miles from the nearest railroad at Red Bluff. The claim was leased to Vance and Barnes in 1940, who carried on development work in the spring of 1941 but operations were soon abandoned and no work has been done since.

The ore consists of manganiferous iron oxide in more or less thin-bedded chert, which is surrounded by greenstone. The chert strikes east and dips nearly vertically. It is resistant to erosion and forms a prominent ridge. The ore zone is in two parts: One about 200 feet long, on the west end, and the other about 150 feet long on the east end. Between the two mineralized zones is a barren zone about 50 feet in length. The ore in the east deposit is estimated to contain less than 3 percent manganese, and in the west deposit about 5 percent. The ore is similar to that found at the Arrowhead claim (Trinity 6). It is dark brown and gives a dark brown streak. An assay from the west deposit gave 3.80 percent manganese. The iron content was not determined, but by analogy with similar deposits in the general region, it probably is of the order of 20 percent. The low manganese and high iron content cause this deposit to have little promise, even though the tonnage is high. The ore zone is completely surrounded by greenstone, and it may give way to greenstone with depth.

No. 39. Emma Group. (By Parker D. Trask, October 1942.) The Emma group of claims is the westernmost of the group of claims located by John Mosier on North Yolla Bolly Mountain in secs. 32 and 33, T. 27 N., R. 10 W. For details see the description of the Bertha group (Trinity 9).

No. 40. Foss Prospect. (By R. R. Morse, August 4, 1918.) Two claims belonging to Fred Foss of Knob Post Office, lie on a steep hillside north of Dubakella Creek, in sec. 16, T. 29 N., R. 11 W. They are leased to the Noble Electric Company. Several pits were excavated and the ore sampled.

The material considered to be ore by the prospectors consists of a dense black chert heavily stained with manganese oxides. Near the surface, fragments of this chert exhibit outer rims of soft sooty manganese oxides mixed with a small amount of limonite. The proportion of this material to hard rock is very low. Fresh specimens of the rock from the bottoms of pits are very dark green to black, showing a dense flinty


N
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19°
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greenstone
SCALE OF MAP
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inesite veins
sandstone
red, laminated, cherty shale and greenish chert
6" white chert
chert grades into sandstone
manganese ore body
chert
sandstone
greenstone
complicated by faulting
0 50 100 150 FEET
SCALE OF SECTION

Geology by W. G. Pierce
Topography by F. D. Trauger
August 1941

Ore is mixture of manganiferous chert, rhodochrosite and hausmannite; the latter being more abundant near center of ore body. Many veins of calcite and inesite cut the ore near the greenstone. Veinlets of pink rhodochrosite and resinous neotocite cut other minerals. Wallrocks are chert, sandstone, and intrusive greenstone, of Franciscan group

PLANE OF SECTION N 19°E., ABOUT 100 FEET NORTHWEST OF OUTCROPS AS SHOWN ON AREAL MAP.

By Max D. Crittenden Jr., August, 1944.

FIGURE 10. Geologic map and section of the Hale Creek mine, Trinity County, California.

texture and subconchoidal fracture, some being clearly but not conspicuously banded. The rock is apparently a manganiferous chert. A small amount of pyrite is present.

No. 41. Four Point Claim. (By Parker D. Trask, June 1941.) The Four Point claim is located on the east side of a road leading south from the forest road to Limedyke in the NW¼ sec. 29, T. 1 N., R. 8 E., at an altitude of 4,500 feet. It was located by R. Sihlis on October 26, 1940. It consists of a mass of low-grade manganiferous chert not over 4 feet in diameter in chert associated with greenstone. The grade is estimated to be less than 10 percent manganese. About 20 tons of ore of this grade is believed to be present.

No. 42. Gool No. 2 Claim (By Ivan F. Wilson, July 24, 1941.) The Gool No. 2 claim is in the SW¼ sec. 30, T. 1 N., R. 8 E. It is on the west bank of the middle fork of North Rattlesnake Creek, about 1 mile by trail south of the Bear Wallow Forest Service Road. It is 80 miles from the nearest railroad. The claim was located on August 15, 1940, by Charlotte M. Patton and J. W. Patton. This property is said to have been prospected for manganese during the Spanish-American War.

One prospect pit 4 feet in diameter and 4 feet deep has been opened in a belt of manganiferous red and purple chert, which is 20 to 25 feet wide and exposed continuously for a length of 125 feet. Another exposure of manganiferous chert occurs 400 feet southwest of the pit, but greenstone lies between. The chert strikes N. 60° E., and dips 45° N. It abuts on serpentine 600 feet southwest of the pit, and in other directions is surrounded by greenstone. The chert is stained with manganese oxide. In places a small amount of oxide penetrates the chert. The primary mineral is apparently brown manganese chert. The ore exposed in the pit contains 10 to 15 percent manganese, but the general run of the belt is 10 percent or less.

No. 43. Gool No. 3 Claim. (By Ivan F. Wilson, August 4, 1941.) The Gool No. 3 claim is on the top of a ridge about 300 yards southwest of Gool No. 2 (Trinity 42). The claim was located August 31, 1940, by Ralph A. Patton. The point of discovery is 300 feet north of the quarter corner between secs. 30 and 31, T. 1 N., R. 8 E. The claim contains three bodies of manganiferous red and purple chert of a type similiar to that on Gool No. 2. These bodies from south to north are 35 feet long, 20 feet thick; 20 feet long, 10 feet thick; and 70 feet long, 20 feet thick, respectively. The chert is surrounded by greenstone, and serpentine appears to the west. The bodies contain coatings of manganese oxide, which has probably developed from manganese chert. The average grade is around 5 percent. The southernmost body contains a bed 10 feet long and 3 feet thick which contains about 25 percent manganese. It consists of black oxide ore cut by quartz veins and containing patches of yellow-brown manganese chert.

No. 44. Hale Creek Mine. (By Parker D. Trask and W. G. Pierce, August 1941.) The Hale Creek mine is on the west side of the Mad River at an altitude of about 3,000 feet in the NW¼ sec. 23, T. 1 S., R. 6 E. It was located by S. Hutchins and H. T. Moore of Ruth, and is leased to W. Doty and S. Killingsworth of Mad River. The deposit is served by a steep road, 2 miles in length. A temporary bridge is built across the Mad River, but this bridge washes out in the winter season. The shipping point for the ore is Carlotta or Alton on the Northwestern Pacific Railroad, a distance of 55 miles. No ore has been shipped, but in the summer of 1941 about 600 tons was mined and placed in a stock pile beside the mine. A chute has been built from the deposit to the stock pile and another chute from the stock pile to the loading bin below.

The Hale Creek mine is one of the more promising manganese deposits in northern California. The ore consists principally of carbonate, which cannot be marketed according to present specifications. It forms a massive bed 125 feet in length and 10 feet in maximum thickness, lying nearly horizontal in a sequence of thin-bedded white chert, which in turn is in sandstone. The outlines and setting of the ore are shown in the accompanying map of the deposits made by W. G. Pierce and S. C. Creasey (fig. 10).

The deposit is near the crest of a flat-topped spur and the ore is mined by stripping the overburden. The face of the ore body has been cut back about 10 feet in the mining operations, and the ore that has already been mined has been produced at relatively little cost, as operations consist of blasting the face of the ore and then placing it in the chute leading to the stock pile.

The ore differs from other California manganese ores. When fresh it is light gray or white in color, and looks like a mixture of manganese, carbonate, and bementite. Crystals of inesite nearly half an inch in thickness have been found in the ore, and small amounts of chrysocolla, native copper, and cuprite are present. Assays of 1 and 0.09 percent copper have been reported. In places the ore is dark reddish-brown, and resembles the hausmannite in the Armstrong and Blue Jay properties (Trinity 5 and 20) 25 miles to the southeast along the strike. The ore is cut by small quartz veins about one-sixteenth inch in width. Samples taken from the stock pile average 38 percent manganese and 22 to 25 percent silica.

Hale Creek Mine. (By Max D. Crittenden, Jr., August 30, 1944.) The Hale Creek mine was operated in 1943 by W. H. Snyder, and during 1944 by Snyder and Rae F. Helmke. So far, 3,829 tons of managanese has been produced, which averaged 42.2 percent manganese, 0.95 percent iron, and 20.9 percent silica.

Mining was done by open cut methods, using a bulldozer to remove the sandstone from above the ore. In August 1944 the mining bench was 175 feet long and 50 to 100 feet wide. The cut bank was at least 40 feet high.

The ore body in the Hale Creek mine is a nearly flat-lying massive tabular lens 150 feet long and 3 to 12 feet thick, enclosed in chert and sandstone of the Franciscan group. Unlike most Franciscan deposits, which occur within chert lenses 10 to 100 times the thickness of the ore. the chert here forms only a thin envelope separating the ore from the sandstone. Near the western end of the ore body is 1 foot to 5 feet of buff or greenish chert interbedded with thinly laminated red shale; near the eastern end the ore is separated from the sandstone above by only 6 inches of white chert. The greenstone near the western end of the ore body appears to be intrusive, since it cuts across the chert and sandstone. Moreover, it appears to have caused marked hydrothermal alteration of the ore near the contact. The relationships of the ore minerals to the adjacent rocks are illustrated in figure 10.

The ore in the original exposure consisted largely of fine-grained manganiferous chert and some manganese carbonate. As mining progressed, the ore increased in length and thickness, and also in grade.

Dark reddish-brown hausmannite began to appear, and this mineral probably constituted about 30 percent of the ore exposed in August 1944. Brief study of two thin sections indicates that the earliest minerals are dark reddish-brown hausmannite, in irregular aggregates, surrounded by bementite and rhodochrosite. These minerals are cut by veins of calcite, rhodochrosite, bementite, and barite. The hausmannite for a distance of one centimeter from the boundary of these veins is altered to a cloudy mass of bementite in which the form of the original hausmannite aggregates is preserved. The bementite in these specimens is very pale tan-colored, and occurs as radiating or cross-shaped fibers. The refractive index is 1.65± and the birefringence is about .010±. The fibers are uniformly slow along the length.

Hand specimens show small amounts of copper minerals, and abundant inesite, a manganiferous amphibole, in veins cutting the ore near the contact with the greenstone. Oxidation of the manganese minerals did not extend more than a few feet from the original surface, except along open fractures. Even there, only films of oxide were produced at the depths exposed in August 1944.

No. 45. Hart and Bear Deposits. (By Parker D. Trask, August 1941.) The Hart and Bear claims are located in NE¼ sec. 3, T. 26 N., R. 12 W., on the east side of the middle fork of the Mad River 3 miles above Three Forks at an altitude of 3,200 feet. Two claims lying side by side were taken out in June 1941 by J. M. McKnight and associates. Development consists of a shallow trench on each deposit. They both are low-grade deposits of manganiferous chert in more or less thin-bedded chert. The grade is less than 15 percent manganese. The structure in the region is complicated, and the relation of the two deposits to each other is obscure. They are about 1,500 feet apart, the Bear claim lying northwest of the Hart claim.

No. 46. High Lead Claim. (By Parker D. Trask, August 1941.) The High Lead claim is in sec. 13, T. 29 N., R. 12 W., about 100 feet south of the Red Mountain road, 80 miles from the nearest railroad. It was located by W. R. Shields. The deposit consists of manganese-stained chert, which is estimated to contain less than 2 percent manganese. No ore of commercial grade was seen.

No. 47. Jaybird Claim. (By Ivan F. Wilson, August 17, 1941.) The Jaybird claim is in the NW¼ sec. 33, T. 1 N., R. 8 E. It is on the west bank of Long Gulch, just west of Long Gulch Spring, which is at the intersection of the Long Gulch Trail and the trail to Glade Camp. It is about 2.5 miles by trail south of the Bear Wallow Forest Service road, and 75 miles from the nearest railroad. The claim was located August 15, 1941, by Henry W. Hoelling of Forest Glen.

The deposit consists of a body of manganiferous red chert. Manganese oxide occurs as stains, coatings, fillings, and to some extent penetrations in the chert. No primary minerals were seen, except possibly neotocite or bementite. The manganiferous chert body is 20 feet thick and 70 feet long. Another small outcrop lies 100 feet south, but greenstone apparently occurs between. The chert strikes north and dips 50° E. It is bordered on the west by white chert which strikes N. 25° E., and dips 40° E. Another red chert body occurs farther west, but contains practically no manganese. The rocks surrounding the chert are mostly greenstone. The average grade of the manganiferous chert is less than 5 percent manganese. An assay of a representative sample contained 3.26 percent manganese.

No. 48. Jewett Claim. (By Ivan F. Wilson, July 29, 1941.) The Jewett claim is in the NW¼ sec. 32, T. 29 N., R. 11 W., near the Black Hawk claim (Trinity 17). It is 100 yards west of the Red Mountain Guard Station, which is along the Red Mountain-Wildwood road, 12 miles southeast of the Forest Glen-Hayfork road. The nearest railroad is 70 miles away. The claim was located July 1, 1941, by Ray Latham. The deposit consists of white chert which contains a few thin films and stains of manganese oxide. It is estimated to contain 1 percent manganese or less. The chert strikes east and dips 45° N. Serpentine occurs both north and south of the deposit.

No. 49. Kekawaka Deposit. (By Parker D. Trask and Frank S. Simons, April 8, 1942.) The Kekawaka deposit is located on the William P. White ranch in the NE¼ sec. 14, T. 4 S., R. 6 E. The deposit is 1 mile from a road and 10 miles from Alder Point. It is under lease to Rae F. Helmke. The deposit was not visited, as Mr. Helmke said it was of low grade and small tonnage.

No. 50. Lampley Deposits. (By Charles R. Warren, August 25, 1941.) The Lampley deposits are situated at an altitude of 2,800 feet, 1.5 miles west of the road from Zenia to Hoaglin, and 13 miles from Alder Point. They are in the NE¼ sec. 33, T. 3 S., R. 6 E., in a region of extensive slumping, on land owned by Jesse Lampley. No development work has been done. Several patches of stockwork manganese oxide as much as 20 feet in width are reported to be present in different parts of the Lampley Ranch. The best seen occupied an area of 10 to 20 feet. As the land has slumped badly, none of these ore bodies can be assumed to be in place, and the source of the ore is not apparent from the present exposures. The grade is estimated to be about 25 percent manganese.

No. 51. Last Chance Claim. (By Ivan F. Wilson, July 21, 1941.) The Last Chance claim is located 1 mile by a poor road south of the Bear Wallow Forest road in the NW¼ sec. 32, T. 1 N., R. 8 E. It is on a ridge east of North Rattlesnake Creek. It was located June 25, 1941, by Sarah T. Hoelling. The distance to the nearest railroad is 80 miles. No development has been done. On the property is a single outcrop of ore 3 feet wide and 4 feet long. No other exposures of ore are in the immediate vicinity. The outcrop consists of soft black oxide ore in light-colored chert and brown manganiferous chert. The ore exposed may run around 30 percent manganese. Northeast of the outcrop is a body of white to gray chert, which strikes N. 45° W. North of this chert is serpentine which forms much of the ridge lying east of North Rattlesnake Creek.

No. 52. Last Hope Claim. (By W. G. Pierce, August 19, 1941.) The Last Hope claim is in the NE¼ sec. 27, T. 31 N., R. 11 W., about 5 miles south of Hayfork, 100 feet west of the road to Wildwood. It was located by Mildred M. White on February 3, 1941. The point of location is 0.3 mile south of the Leach Ranch bridge. The deposit consists of dark gray manganese-stained chert which contains less than 2 percent manganese. The strike is N. 70° W., and the dip 60° S. The chert is 75 feet thick.

No. 53. Little Deer No. 1 Prospect (Trinkle and Purcell). (By E. F. Davis and A. O. Woodford, August 17, 1918.) Three Trinkle and Purcell prospects are situated on Brushy Mountain in sec. 17, T. 25 N.,

R. 12 W. They are covered by three mining claims called Little Deer No. 1, Little Deer No. 2 (Trinity 54), and Bald Steer (Trinity 7) claims. These prospects lie 25 miles from Covelo, 5 miles from the road to the Amador Short Ranch. The Little Deer Prospect No. 1 was located by A. G. Trinkle. In this deposit a small open cut exposes a body of low-grade siliceous ore. The ore is in thin-bedded chert, separated by soft shale partings. The manganese is in veinlets and impregnations in chert. A representative sample ran 16.7 percent manganese and 62.9 percent silica.

No. 54. Little Deer Prospect No. 2. (By E. F. Davis and A. O. Woodford, August 17, 1918.) The Little Deer No. 2 prospect was located by A. G. Trinkle, W. H. Dobbins, and G. E. Purcell of Covelo. It is near the south center of sec. 17, T. 25 N., R. 12 W. The ore body is enclosed in thin-bedded red to gray chert. It is exposed in three open cuts, the two extreme cuts being 75 feet apart. Exposures of ore between the open cuts indicate that the ore body is continuous for this distance. On its south end the ore body is cut off by a fault.

The north end of the ore body is siliceous and consists of black oxide ore containing numerous cores of iron-stained silica skeletons. In the northern open cut the ore body is 12 feet wide. A sample of the north end of the ore gave manganese, 14.7 percent; and silica, 67.3 percent. The southern part of the ore body is less siliceous. A sample contained 27.9 percent manganese and 47.1 percent silica.

No. 55. Lookout Deposits. (By Charles R. Warren, August 25, 1941.) The Lookout deposits are a short distance west of the crest of Grizzly Mountain at an altitude of 5,400 feet in the NE¼ sec. 34, T. 2 S., R. 6 E. The deposits were located June 12, 1941, by George A. Kniss and Lee Murphy. They are 0.3 mile from the Forest Road, and 22 miles from Alder Point, the nearest rail point. No development work has been done. The deposits consist of two bodies of dark rock separated by chert. The dark rock looks like it is high in iron and low in manganese. It contains considerable pyrite and a small amount of copper. The manganese content presumably is about 10 percent. The larger body is exposed for 6 feet and has a width of 3.5 feet. The strike is north and the dip is steep to the west.

No. 56. Lost Mine Deposit. (By Charles R. Warren, July 30, 1941.) The Lost Mine deposit is situated at an altitude of about 3,300 feet on the east side of the Mad River 2 miles east of the Double-A Ranch in the SW¼ sec. 16, T. 3 S., R. 8 E. The deposit was located July 7, 1941, by F. A. Stockel and J. M. McKnight of Ruth. The deposit lies 0.3 mile by trail from the road on the east side of Mad River, and 72 miles from the railroad at Carlotta. Four trenches were dug during the summer of 1941, but owing to the relatively low grade, no ore has been shipped.

The ore consists mainly of stock work ore in chert, the average grade being of the order of 20 percent manganese. One cut, however, shows 4 feet of ore estimated to contain 30 percent manganese. The strike is northwest and the dip vertical. The greatest width of the ore body is 10 feet. The linear extent is not indicated, because of overburden. The four cuts exhibit the following relationships:

Cut 1 is 14 feet wide and 6 feet deep, showing 10 feet of ore averaging about 20 percent manganese, but one zone 4 feet in width is estimated to contain 30 percent. Cut 2 is 40 feet northeast of cut 1, across the strike.

A ton of high-grade ore lies on the dump here, but no manganese was seen in place. Cut 3 is 180 feet N. 57° W. of the pine tree at the head of the center of cut 1. Here an 8-foot trench shows manganiferous white chert resting against sandstone and shale. The grade of the ore is about 20 percent manganese. The ore is seen to tongue out and end abruptly in the sandstone and shale. Cut 4 is 20 feet southwest of cut 3. A 15-foot trench shows ore containing about 30 percent manganese. This ore is believed to be analogous to the ore in cut 1, whereas the ore in cut 3 is probably the continuation of the ore in cut 2.

No. 57. Louella Group. (By Parker D. Trask, June 1941.) The Louella group of claims is the northeasternmost of three claims located in SW¼ sec. 30, T. 31 N., R. 12 W., called the Carr, Carrie, and Louella claims. For details see the description of the Carr and Carrie claims (Trinity 28 and 29). The Louella claim was located in the fall of 1940 by B. E. McFadden of Hayfork. It has not been developed.

No. 58. Lucky Bill Prospect (Old Bill, Johnston). (By Parker D. Trask, October 1942.) The Lucky Bill deposit is situated at an altitude of about 4,000 feet near the center of sec. 9, T. 28 N., R. 11 W. The claim was originally located in 1917 by Don Noble, William Noble, and William Johnston of Knob. Several pits were dug at that time, but no ore was shipped. In the summer of 1941 the claim was relocated by T. E. Reynolds of Davis, who has blazed a trail from Pine Root Springs to the deposit. The claim is about 2 miles from the Forest road to Red Mountain Lookout, and is about 65 miles from Red Bluff, the nearest rail point. Ore would have to be hauled over a divide 5,400 feet in altitude on this route, which would make trucking in winter a serious problem.

The ore consists of rhodonite, rhodochrosite, bementite, and manmaniferous chert in varying proportions. At least four ore bodies are present in a belt of chert associated with greenstone. The length of these ore bodies is 20, 80, 110, and 30 feet, respectively. The chert strikes northwest and dips nearly vertically. The ore is exposed at intervals over a distance of 400 feet, and it varies in width from 2 to 10 feet, but the average is about 5 feet. The deposit appears to be discontinuous, as greenstone is found between the manganese exposures. The greenstone seemingly has cut off the chert containing the manganese, and the ore looks as though it might be part of a roof pendant in the greenstone. A representative sample, collected by R. R. Morse in 1918, across the face of one of the ore bodies gave manganese, 46 percent, iron 1.5 percent, and silica, 14.7 percent.

The ore is similar to the ore at the Manganese Queen (Trinity 61) and Spider (Trinity 84) mines which are located within 10 miles of this deposit. Very little oxide is present, as the ore passes into the primary minerals within a few inches of the surface of the ground. Not over 100 tons of oxide can be expected. The deposit contains a sizeable amount of ore having a fairly high percentage of manganese, and if some market is developed for siliceous ore of this type, the deposit should receive favorable consideration.

No. 59. Lucky Star Claim. (By W. G. Pierce, August 7, 1941.) The Lucky Star claim is in SW¼ sec. 6, T. 29 N., R. 12 W., half a mile from the state highway along Post Creek. The claim was located by Robert Shields. Two small pits 10 feet in length and 3 feet in width have been dug exposing low-grade manganiferous chert containing about 10 percent manganese. In one pit a 6-inch band of manganese carbonate is present, but it cannot be traced on the surface of the ground. The strike of the ore is N. 80° E., and the dip 35° N.

No. 60. Lucky Sunday and Billy Sunday Claims. (By Parker D. Trask and Max D. Crittenden, Jr., September 1942.) The Lucky Sunday and Billy Sunday are two northwest-trending claims at an altitude of about 3,000 feet near the head of the Mad River in the NW¼ sec. 32, T. 27 N., R. 12 W. They were located by J. M. McKnight and F. A. Stockel on June 18, 1941. The Lucky Sunday as originally staked lay northwest of the Billy Sunday. Subsequently the owners found that the outcrops of the ore on the two claims lay entirely within the confines of a single claim; so the Billy Sunday was dropped. The deposits are 0.3 mile from the road up the south fork of the Mad River to the Blue Jay mine, and are 75 miles from the railroad at Carlotta. The beds strike N. 35° W. and dip nearly vertically. Ore is found at three places on the property, and several pits have been opened.

On the northwest end of the claim, an open cut 40 feet long and 15 feet wide exposes a 4-foot bed of manganese ore lying in thin-bedded chert of the Franciscan group striking N. 35° W., and dipping 35° NE. The ore bed consists of the following zones:

Top—porous leached oxide ore—40 percent Mn	10 inches
Partly leached cherty ore—25 to 30 percent Mn, 25 percent SiO_2	2 feet
Sheared zone with oxide ore—40 percent Mn	4 inches
Partly leached cherty ore with powdery silica remnants and occasional sheared zones with oxide ore	1 foot

The primary ore consists of a buff, chalcedonic, manganiferous chert containing bands of granular tan rhodochrosite. The carbonate makes up about 15 percent of the rock. The length exposed is 30 feet, and the total length between outcrops is 60 feet. Six feet stratigraphically below this bed is a second somewhat thinner ore bed. The extent of this bed is unknown owing to the lack of exposure.

Near the center of the claim, in a swale on top of the ridge, a small pit exposes a thin bed of low grade oxide ore interbedded with red chert and greenish cherty shale. At the south end of the claim, an open cut 25 feet long, 4 feet wide, and up to 10 feet deep follows the outcrop of a bed of ore, which resembles the above ore in the central workings, except that it seems to carry a larger proportion of carbonate. The bed ranges from 4 inches to 2 feet in thickness, and is exposed for a length of 35 feet. A sample of the ore assayed 32 percent manganese and 33.5 percent silica.

Lucky Sunday Mine. (By Max D. Crittenden, Jr., August 30, 1944.) The Lucky Sunday mine was operated by J. P. Warren in 1943. Development included a road to the property, an inclined open stope on the ore bed, and an adit that intersects the stope about 40 feet below the original outcrop. In 1943, 200 long tons of ore averaging about 40 percent manganese ore was reported to have been produced. The oxide ore appears now to be entirely mined out. A second manganiferous bed crops out in a road cut a quarter of a mile southeast of the first bed. Only a few tons of oxide ore remain here.

No. 61. Manganese Queen Mine. (By Parker D. Trask, November 1942.) The Manganese Queen mine is situated at an altitude of approximately 3600 feet near the head of Post Creek in SE¼ sec. 26, T. 30 N., R. 12 W. The claim was located by Charles Crews of Harrison

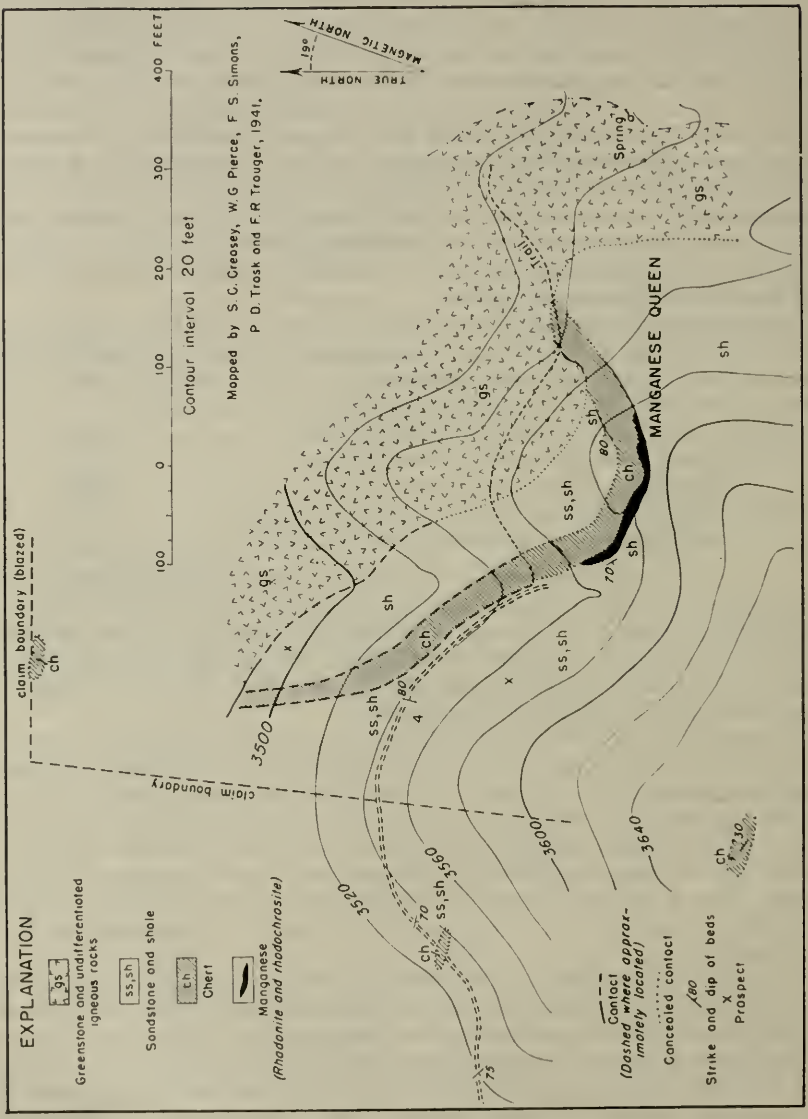
EXPLANATION
gs
Greenstone and undifferentiated igneous rocks
ss,sh
Sandstone and shale
ch
Chert
Manganese
(Rhodonite and rhodochrosite)
Contact
(Dashed where approximately located)
Concealed contact
80
Strike and dip of beds
x
Prospect
claim boundary (blazed)
claim boundary
100 0 100 200 300 400 FEET
Contour interval 20 feet
Mapped by S. C. Creasey, W. G. Pierce, F. S. Simons, P. D. Trask and F. R. Trauger, 1941.
TRUE NORTH
MAGNETIC NORTH
19°
Spring
Trail
MANGANESE QUEEN
gs
sh
ss,sh
ch
3500
3520
3560
3600
3640
80
70
75
30
4

FIGURE 11. Geologic and topographic map of the Manganese Queen mine, Trinity County, California.

Gulch Ranger Station in 1937. It is reported to have been leased to several persons, among whom are Vance and Barnes, and I. D. Budd. It was also mined during the last war, and 75 tons of ore was piled on a dump about half a mile from the deposit, but apparently no ore was actually shipped at that time. In the summer of 1942 the mine was leased by A. Gronzotto, Lloyd A. Whitsun, and David H. White of Berkeley and Walnut Creek. These people improved the road to the deposit, and in September 1942 began to ship ore from the north end of the ore body. The ore was trucked 75 miles to Redding, where it was placed in a stock pile at the gravel plant. It was then crushed to pass a three-quarter-inch screen and shipped to a former zinc plant in Richmond, where it was calcined in a small rotary kiln about 30 feet in length, and shipped to the Metals Reserve Company in Sacramento. Operations were abandoned about November 1, 1942, presumably because the ore was found to contain more rhodonite as mining progressed. From the present appearance of the ore body, about 600 tons of ore had been mined. As of November 1, 1942, 300 tons had been shipped to the stock pile in Sacramento. The ore was mined from an open pit occupying the area shown in black on figure 11. The soft chert and shale at the sides of the ore body were scraped away by a bulldozer, leaving the ore body rising from 5 to 15 feet above the ground. The ore was mined from the north toward the south, and at the cessation of the operations about one-third of the ore body that protruded above the ground had been removed.

The ore body consists of a mass of rhodonite, bemenite, and rhodochrosite, in thin-bedded chert, which in turn is near a mass of greenstone. The ore body is a massive crescent shaped ledge about 140 feet long and 11 feet in maximum width. It averages at least 8 feet in thickness. A geologic and topographic map of the deposits was made in July 1941 (fig. 11).

The general strike of the region is northwest, and the dip is nearly vertical. Thick soil obscures the geologic relationships. The chert which lies north of the ore body is bounded on the west by clastic sediments, and on the east by greenstone. Greenstone is also found west of the clastic sediments on the west side of the ore body. The ore body is bounded by a vertical fault which brings greenstone against chert about 10 feet southwest of the ore body. This fault and greenstone are not shown on figure 11.

The ore minerals are rhodonite, rhodochrosite, and bementite. The northwest end of the ore body is predominantly rhodochrosite and bementite, and the east end predominantly rhodonite and bementite. The rhodonite is clearly later than the rhodochrosite, and seemingly has replaced it. Much of the rock consists of a mineral that resembles bementite. It is soluble in acid and it gelatinizes, but does not have the typical optical properties of bementite. Moreover, the high manganese content (42 to 45 percent) in much of the raw ore, suggests the presence of some other mineral, perhaps braunite or hausmannite, or a hydrous silicate richer in manganese than ordinary bementite. The X-ray pattern gives no direct indication of braunite, hausmannite, or bementite, though some of the lines could come from braunite. The ore gives off considerable water, which, together with the gelatinizing with acid, suggests a peculiar hydrous silicate, relatively rich in manganese. A detailed report upon the nature of the ore by Max D. Crittenden, Jr. is given below. At the north end about 90 percent of the ore is soluble in sulphur dioxide, and only 10 percent, which presumably is rhodonite, is insoluble. This ore responded nicely to calcining, as the manganese content is reported to have been raised from 42 to 48 percent by the heat treatment. The percentage of acid insoluble manganese is materially higher in the ore from the south end where more rhodonite is present. In places the ore at the south end consists of purplish-pink rhodonite with interstitial calcite, and a few thin bands and veins of calcite and rhodochrosite.

The ore now in sight is estimated to be about 500 tons; the indicated ore, 1,500 tons; and the inferred ore, 7,500 tons. The average grade of ore is estimated to be 40 percent manganese. The raw ore that was mined from the north end of the ore body contained between 40 and 45 percent manganese. Since much of the raw ore is soluble in sulphur dioxide, the deposit is amenable to leaching, and even though operations have now been abandoned, the deposit has definite possibilities of being susceptible to some sort of treatment that will make the ore marketable. It would be appropriate to conduct metallurgical tests upon this ore in order to ascertain more fully its possibilities. If it should prove usable, then another 10,000 tons of inferred ore of similar type would also be available from the Lucky Bill (Trinity 58) and the Spider (Trinity 84) deposits which are similar to the Manganese Queen deposit, and lie in the same general vicinity.

Manganese Queen Mine. (By Max D. Crittenden, Jr., November 1942.) The assemblage of rhodonite, bementite, and rhodochrosite in the Manganese Queen mine (Trinity 61) led to a detailed investigation of the paragenesis of these minerals. Thanks must be extended to several of the departments of the University of California who have made this work possible: to W. H. Dore of the Department of Plant Nutrition who kindly consented to make the X-ray patterns, and was generous of time and assistance in interpreting them. To Professor W. P. Kelley and Dr. J. B. Page of the Department of Soil Science who extended the use of laboratory equipment, and reagents for making chemical analyses.

In the field the ore is greenish to brown, though in places it is purplish pink. The rock is veined by varying quantities of pink rhodonite, or locally completely replaced by it. It is also cut by thin veins of calcite and bementite. Below a depth of 10 feet, indications of superficial alteration are reduced to knife edge films of oxide. Material that is obviously rhodonite is sorted from the shipping ore at the mine.

A microscopic study was made of thin sections cut both from samples taken direct from the mine, and from crushed ore at the calcining plant at Richmond. These samples show that the raw ore consists largely of the following materials:

(1) Hydrous silicate (?), a weakly anisotropic brown to yellow-brown material. In thin section observed to be clouded by numerous minute rodlike (possibly plate shaped) forms, the whole serving as a "groundmass" for rhombic carbonate crystals. Index of refraction is 1.60φ. Elongation of the rods is positive.

(2) Rhodochrosite: (a) as finely divided granular aggregates resolvable only under highest power, and giving no extinction, (b) as clear euhedral crystals with rhombic form and good cleavage.

(3) Rhodonite: (a) anhedral to subhedral grains and blades embedded in the aggregates of carbonate and hydrous silicate, (b) granular veins cutting both the carbonate and the hydrous silicate. The optical properties are variable: 2V=60° to 90° optically negative; and 80° to 90° optically positive. Nm is approximately 1.738.

The texture and structure of the ore is probably metamorphic. Evidence of primary and sedimentary structures is lacking. Yet only the rhodonite and part of the rhodochrosite show definite evidence of being secondary. The hydrous silicate may have been originally deposited as amorphous material with a variable composition (neotocite?). This has been partly recrystallized to form the weakly anisotropic form now present. It is no longer entirely amorphous, has a higher index of refraction, and shows the development of definite crystalline forms.

The carbonate does not seem to be replaced by the hydrous silicates. On the contrary, the appearance suggests that the hydrous silicate was itself replaced during recrystallization of the carbonate. Large areas of the ore consist of finely granular carbonate, some of which is probably primary, but part of which has certainly been recrystallized. Locally the process of recrystallization has yielded clear euhedral rhombs scattered through the hydrous silicate. Elsewhere incomplete or partial crystals and coarse aggregates clouded by inclusions of hydrous silicate have been formed.

The rhodonite appears as subhedral blades or irregular grains replacing the other minerals, leaving angular interstitial areas of carbonate or hydrous silicate. Granular veins of rhodonite also cut areas of carbonate. The formation of the rhodonite is perhaps the result of moderate hydrothermal metamorphism.

The superficial alteration of the ore has been shallow, and of little consequence. In thin section the hydrous silicate appears to be more oxidized than the adjoining areas of carbonate.

Chemical analyses of the ore were made in order to ascertain approximate values for the amounts of the mineral constituents. Each sample was first analyzed for total manganese. A second portion was agitated for 72 hours in 6 percent sulphuric acid, and the manganese determined in the residue. The difference between the total manganese and that in the residue is assumed to represent available manganese. Two such analyses of mill-run raw ore are tabulated.

	Total Mn	Insoluble Mn	CO_2	SiO_2	Loss on ignition 100°-600° C.
No. 1a, raw ore general sample	44.94%	3.81%	2.9%	19.9%	9.1%
No. 1b, raw ore fines	44.05%	2.95%	2.7%	not determined	not determined

Even though all the carbon dioxide were present as rhodochrosite, the amount apparently accounts for only a small part of the soluble manganese. The remainder may come from two sources. The first is the small amount of superficial oxide which may be admixed with the ore. However, the contribution from this source is believed to be small. The second source is the isotropic material observed microscopically, and thought to be a hydrous silicate. It seems certain from these results that this material is present in larger quantities than originally suspected. It probably makes up at least 50 to 60 percent of the ore.

The presence of a hydrous silicate was first suspected by the commercial analyst who assayed the ore for the Metals Reserve Company, because leachings from the sulphurous acid treatment were found to yield abundant silica gel on evaporation. More critical evidence is apparent from inspection of the losses observed during laboratory heat treatment of the ore.

	Percent
Observed loss in calcining (100°-600° C.)	10
Loss due to $MnCO_3$ decomposed	3
Difference, approximately	7

If, as is thought, this difference represents water of hydration expelled during the decomposition of a hydrous silicate, its magnitude is within the range required for an ore containing about 80 percent bementite ($H_{10}Mn_8Si_7O_{28}$). It is apparent, however, that the manganese content as shown in the analyses is too high to correspond to this mineral. An X-ray pattern was made of the analyzed sample 1a, and of a carefully picked sample of bementite from the Ladd mine, San Joaquin County, furnished by Professor Hulin of the University of California. It proved impossible, however, either to confirm or deny the presence of bementite on the basis of these patterns. This was due to the weakness of the pattern produced by the bementite in comparison with the rhodochrosite, whose strong lines obscure the other lines.

As it is impossible to obtain even by hand picking pure samples of the hydrous silicate for analysis under the microscope, any inference as to its composition must be based on the above very incomplete analysis of the entire ore. Deducting the manganese known to be present as rhodochrosite and rhodonite from the total manganese, the remainder is approximately 35 percent manganese, or 45 percent manganese oxide on the basis of the total ore, which may be ascribed to a hydrous silicate. Similarly, after deducting the silica present as rhodonite from the total silica, the remainder is approximately 15 percent silica. After deducting the carbon dioxide from the total loss from 100° to 600° C., approximately 7 percent of water remains. Recalculated on the basis of 100 percent, this gives a ratio of $MnO:SiO_2:H_2O$ of 6:2:1. It must be emphasized, however, that this is not to be construed as an exact composition, but merely indicates roughly the chemical nature of the material that is the principal source of the manganese in this ore.

If, as has been suggested, this material was originally deposited as an amorphous mixture of manganese oxide, silica, and water, there seems to be little reason why the proportions need be fixed in any given ratio. Instead, they would depend essentially on the relative abundance of the manganese and silica at the place and time of deposition. In the presence of small amounts of carbon dioxide, a mixture of a hydrous silicate and carbonate such as is found in this ore might be expected.

Calcining of the ore is carried out in an inclined rotary kiln formerly used for zinc oxide. The temperatures vary from 600° to 800° C., and the time of heating is 10 to 15 minutes. The physical effect on the ore is relatively slight. The angular fragments retain their original shape, though they are somewhat softened. The ore does not crumble or powder. Except for the rhodonite, it is thoroughly blackened.

The following is a tabulation of analyses of three samples of mill-run calcined ore. The first two roughly correspond to the first of the raw ores previously tabulated:

	Total Mn	Mn insoluble in H_2SO_3	CO_2	Rhodonite (calc. from insol. Mn)
No. 1b, calcined ore approx. 600° C.	48.67%	7.73%	1.17%	16.08%
No. 1c, calcined ore approx. 800° C.	49.86%	8.43%	0.939%	20.25%
No. 2b, calcined ore fines	50.14%	4.22%	0.678%	10.08%

It will be noted that the total manganese has increased over that in the raw ore, but that the increase is only in the neighborhood of 5 percent. The carbonate naturally decreased, but has not been completely decomposed, even at the higher temperature. It appears that at 700°, approximately 60 percent of the carbonate in the lump ore has been decomposed, and at the higher temperature, the proportion increases to about 70 percent. A higher percentage of the fines is decomposed at moderate kiln temperatures, due to the physical factors involved.

The increase in the amount of rhodonite in the calcined product is greater than would be expected from the corresponding benefication of the total manganese. It is suspected that this is due to a sampling error. Since the kiln is in continuous operation, exact comparisons between the raw and calcined samples are not possible. However, it is possible that some rhodonite might form during the process.

In order to gain more specific information as to the nature of the ore, X-ray powder patterns of several samples were made by W. H. Dore at the University of California. The reference spacings for $MnCO_3$, MnO, and Mn_3O_4 were taken from the paper by Hanawalt, Rinn, and Freyel.[1] These spacings are indicated by the authors as having been checked against the established unit cells for these substances. The reference spacings for Mn_2O_3 were taken from the card index of X-ray spacings published jointly by the American Society for Testing Materials, and the National Research Council.

The spacings for rhodonite were obtained and measured by Dore from parts of a rhodonite crystal in the collection of the University of California Department of Geological Sciences, and have been partly compared by him with the unit cell measurements reported by Wyckoff in "The Structure of Crystals."[2] Dore states:

"The material is obviously heterogeneous. The data support the view that some of each of the first four compounds ($MnCO_3$, MnO, Mn_2O_3, and Mn_3O_4) are present, since the strongest lines in the reference pattern of each are represented by corresponding lines in the pattern of the calcined ore, and with the intensities that are in general of the expected magnitude. A few lines designated by question marks have not been identified. Rhodonite does not appear to be present in any significant proportion. While some of the lines in the ore pattern are indeed like those in the rhodonite pattern, the intensities are not of the correct order."

Because of its low symmetry, it is difficult to detect rhodonite in powder patterns of this sort, though the amount present may actually exceed that of a more highly symmetrical mineral, such as rhodochrosite. It is clear that at the temperatures involved, only partial decomposition of the carbonate is obtained. The oxides are interpreted as being the result of decomposition of the carbonate and the hydrous silicate. The relative proportion of the various members of the oxide group appears to be variable, and is thought to depend on the physical and chemical conditions existing during the calcining process.

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[1] Hanawalt, J. D., Rinn, H. W., Freyel, L. K., Chemical analysis by X-ray diffraction: Ind. and Eng. Chemistry (analytical edition), vol. 10, no. 9, pp. 457-512, 1938.

[2] Dore, W. H., University of California, Dept. of Plant Nutrition. Personal communication.

The differential thermal curve was run on sample 1a to determine the approximate temperature or range of temperatures of decomposition of the hydrous manganese silicate. The principal endothermic peak occurs at 535° C., which corresponds approximately to the decomposition temperature of rhodochrosite. However, the weight loss observed from 100° to 600° C. is more than three times that to be expected from the decomposition of the $MnCO_3$ actually present. Since no other marked endothermic peaks are within this range, this weight loss also represents dehydration of the hydrous silicate. The loss in weight appears to begin at about 450° C. and to reach its maximum at about 535° C. The other two peaks (endothermic at 915° C. and exothermic at 965° C.) represent heat effects accompanying changes in the state of oxidation of manganese oxides present.

The conclusions are: (1) the calcined product consists essentially of a mixture of manganese oxides, MnO, Mn_2O_3 and Mn_3O_4, which account for over 90 percent of the available manganese in the samples examined.

(2) A small amount of carbonate, which is unaffected by the calcining process, is likely to be present. This accounts, however, for less than 10 percent of the available manganese in the samples examined. As would be expected, this residuum decreases as calcining temperatures are raised.

(3) The relative proportion of the higher valence oxides increases as the temperature of treatment is raised.

No. 62. Mary Lue Claim. (By W .G. Pierce, August 8, 1941.) The Mary Lue claim is in the SW¼ sec. 32, T. 2 S., R. 8 E., on the east side of the Mad River about 8 miles south of Ruth. It is about half a mile from the road, and 70 miles from the railroad at Carlotta. It was located by Agnes Wilburn on August 8, 1941. The deposit consists of manganese-stained chert which extends from the base of the hill upward for 200 feet. The only ore seen was manganese stains on chert. The grade is less than 2 percent manganese, and the quantity of ore is small.

No. 63. Montgomery Deposit. (By Parker D. Trask and Frank S. Simons, April 8, 1942.) The Montgomery deposit is on the William P. White Ranch, in the SW¼ sec. 15, T. 4 S., R. 6 E., 1 mile from a road and 10 miles from Alder Point. It is under lease to Rae F. Helmke. The deposit was not visited, as Mr. Helmke said it was of low grade and only a small amount of ore was present.

No. 64. Moody Deposit (Neafus Peak). (By Frank S. Simons, April 8, 1942.) The Moody deposits are located on the Moody Ranch near the crest of Neafus Peak at an altitude of about 3,500 feet in the NE¼ sec. 7, T. 4 S., R. 6 E. Development consists of an adit, now caved, and two trenches, dug in the last war. In 1918 some 63 tons of 40-percent ore are reported to have been shipped. The ore consists of a body of manganiferous chert 80 feet long and 4 feet wide. The strike is N. 10° E., and the dip 30° E. The bulk of the ore is estimated to contain less than 10 percent manganese, but perhaps as much as 1,000 tons of oxide and manganiferous chert containing 25 percent might be present.

No. 65. Munson Group 2. (By W. G. Pierce, August 7, 1941.) The Munson group 2 claim is in the N½ sec. 4, T. 1 S., R. 8 E., on the north side of Post Creek. It is about 1 mile from the road, and 80 miles from Red Bluff, the nearest rail point. The claim was located by W. H. Munson on September 29, 1940. It is situated near the Big Buck claim (Trinity 11). The deposit is a large body of manganese-stained chert, in part recrystallized. The ore is estimated to contain less than 2 percent manganese.

No. 66. Murphy-Bramlette Prospect. (By R. R. Morse, August 6, 1918.) Three manganese claims have been located in sec. 7, T. 28 N., R. 11 W., on the east slopes of the South Fork of Trinity River, about 5 miles west-northwest of the Lucky Bill prospect (Trinity 58). This locality is 10 miles by trail from the White Rock Ranger Station, and thence south three-quarters of a mile through tense brush. The owners are Charles Murphy and William Bramlette.

Outcrops of manganese-stained chert are exposed intermittently in cuts over a length of a few hundred feet, trending northwest. About 2 miles farther to the southeast of these claims a fourth claim (Spider (?) Trinity 84) has been located on similar outcrops which are on the continuation of the strike direction of the manganiferous cherts of the claims under discussion. These rocks appear to be the same as in the Lucky Bill prospect.

The exposures consist of limestone, slate, thin-bedded and massive chert, greenstone, and serpentine. Above the bed of manganese-stained chert is slate 30 feet thick. It is generally black on cross fractures but partings have a silvery appearance owing to sericite. Next to the ore the slate becomes softer, mottled black and white, commonly with a thin layer of light-colored clay along the contact. The slate is followed above by a dense, slightly porphyritic greenstone, usually showing a slight degree of schistosity, but otherwise closely resembling the greenstone of the Lucky Bill locality. Immediately below the ore is a 30-foot bed of evenly banded, cliff forming chert, generally in layers of 1 inch to 1.5 inches in thickness. The strike is N. 45° W., and the dip 45° NE.

Manganese oxide occurs as irregular outer rims and fracture fillings in dense and brecciated chert. Irregular bunches of white porous silica are common. In many places the structure of these chert patches suggests that the chert has been subjected to leaching action, probably providing the irregularly distributed oxide of manganese. Fresher specimens of the chert are dark green or brown, many specimens containing pyrite. The bed of manganiferous chert is not more than 6 feet in thickness. No material of commercial value is exposed. The chert bed as a whole probably contains less than 15 percent manganese.

No. 67. North Fork Deposit. (By W. G. Pierce, August 5, 1941.) The North Fork deposit is situated on the North Fork of the Mad River at an altitude of about 3,000 feet in the SE¼ sec. 21, T. 27 N., R. 12 E. It was located by F. A. Stockel in June 1941. The deposit is 1 mile from the road on the north side of Mad River, and is located along the trail to the Bonanza deposits. It is about 75 miles from the railroad at Carlotta. No development work has been done. The ore body consists of a bed of siliceous manganese 1.5 feet wide in more or less massive white chert. It strikes northwest, and dips 50° SW. It is exposed for less than 50 feet, though the chert zone in which the ore is found extends for 100 yards up the hill from the main exposure along the north side of the creek bed. The grade is 10 to 15 percent manganese.

No. 68. Plummer Peak Prospect. (By Charles R. Warren, August 9, 1941.) A manganese prospect occurs on the main ridge 2 miles west of Plummer Peak, in the SW¼ sec. 33, T. 31 N., R. 12 W. No claim notice was found on the property, but a small cut had been opened. The prospect is about 5 miles by trail north of the Indian Valley road. The distance to the nearest railroad is 75 miles. The prospect consists of manganese-stained red chert, associated with white chert. Manganese is present except in the form of coatings. The prospect is regarded as unpromising.

No. 69. Rainy Day Claim. (By Parker D. Trask, June 1941.) The Rainy Day claim is situated at an altitude of about 4,000 feet in the SW¼ sec. 8, T. 26 N., R. 12 W. It was located on May 26, 1941, by M. C. Fowler, F. A. Stockel, and J. M. McKnight. The deposit is about 100 yards west of the road to the Blue Jay mine (Trinity 20). The whole deposit is confined to a boulder 20 feet long and 4 feet wide, which trends N. 40° W., and slopes 30° SW. It lies in chert, which extends northward from the Blue Jay mine toward the Hayden Roughs. The deposit is 1,500 feet north of the Blue Jay mine, and may be on the eastern limb of a syncline, the western limb of which contains the Blue Jay deposits. The ore mineral is fine-grained rhodochrosite and the grade is estimated to be 40 percent manganese. The boulder was cleared of soil on the surface of the outcrop in 1941, but has not been worked since.

No. 70. Rattlesnake Claim. (By W. G. Pierce, August 6, 1941.) The Rattlesnake claim is in the NW¼ sec. 5, T. 29 N., R. 12 W., adjacent to the road, 75 miles from Red Bluff, the nearest rail point. The claim was located by L. G. Taylor and Hattie Taylor on September 14, 1940. Two pits about 45 feet apart have been opened, exposing a bed of ore 3 feet thick. No ore has been shipped. The strike is N. 85° W., the dip is uncertain as the deposit may be part of a landslide. The ore is a manganiferous chert containing 6 percent manganese, and considerable iron, perhaps as much as 20 percent. It lies in chert in a greenstone region. The low grade of the ore and the uncertainty of the geologic relations make it an unpromising deposit.

No. 71. Red Cliff Prospect. (By E. F. Davis and A. O. Woodford, August 1918.) The Red Cliff prospect is 3 miles south-southwest of a Little Deer prospect (Trinity 53 and 54) on Hulls Creek half a mile below (north of) the mouth of Jesus Creek. Probably it is in sec. 36, T. 5 S., R. 8 E. Two claims have been located by W. J. Azbill of Covelo. From the Amador Short Ranch, 20 miles north of Covelo, a trail is followed down the steep hillside to the junction of Jesus and Hulls Creeks. From here Hulls Creek is followed for half a mile. The deposit is on the east side about 25 feet above the creek.

A small cut 2 feet deep has been opened. The ore occurs as partly oxidized brown carbonate associated with massive and thin-bedded chert. The relations are largely obscured by soil and by talus from the cliff above, but the chert and ore apparently make up a large block broken from the cliff. The ore is a peculiar type of brown carbonate with a dull pearly luster. Minute veinlets of rhodochrosite are fairly numerous. The rock oxidizes on the surface and along cracks to a lustrous black manganese oxide. Under the microscope the brown rock is seen to be made up chiefly of manganese carbonate and of a yellow to brown amorphous substance which evidently contains a considerable amount of manganese, as it passes directly into a black opaque manganese oxide. These two minerals are usually more or less intimately mixed. Specks and aggregates of a cloudy amorphous reddish-brown substance in places are mixed with the carbonate. These substances are red in reflected light and are probably stainings of red iron oxide. No free silica in any form was seen.

The bands and irregular patches of brown manganese carbonate are composed of ill-defined, and mutually interfering spherules, 1 mm. in diameter. Some more or less well-defined crystals of manganese carbonate are present, and these crystals commonly show spherulitic polarization. The specific gravity of this brown rock, free from any black oxides, is 2.85 to 3.01. When this rock is treated with HCl the carbonate goes into solution with effervescence and the manganese is readily leached from the yellow-brown substance leaving a residue of opal. If a fragment as large as 2 or 3 mm. in size is treated with cold dilute hydrochloric acid for several days, the manganese is completely removed, leaving a white porous coherent mass of opal having the outward form of the original fragment. When rubbed between the fingers this breaks down into an almost impalpable powder which, under the microscope, is seen to be opal. When some of the lustrous black oxidized material is treated in a like manner, a similar mass of opal is left. The brown amorphous material mixed with the carbonate, therefore, appears to be a manganese-bearing opal. The form in which the manganese is present, is not known.

This brown ore contains numerous well preserved radiolarian tests, the silica of the tests having been completely replaced by manganese carbonate. These occur both in the carbonate and in the manganese-bearing opal but they are most abundant where the two are intimately mixed. They are excellently preserved and show rather a large variety of forms. Both of the suborders *Spumellaria* and *Nasselaria* are represented. Sponge spicules are also seen.

No. 72. Reichert Claim. (By W. G. Pierce, August 19, 1941.) The Reichert claim is in the S½ sec. 22, T. 31 N., R. 11 W., about 0.8 mile up the north branch of Carrier Gulch, 8 miles from Hayfork. The deposit was located by J. F. Reichert in October 1940. The claim was not visited, as the samples that were seen consist of low-grade manganiferous chert containing less than 10 percent manganese. The claim presumably is similar to the others in the general vicinity.

No. 73. Rice Road No. 1 Prospect. (From files of U. S. Geological Survey, 1942.) The Rice Road No. 1 prospect is located on the Rohrbaugh Ranch half a mile from the road, 8 miles south of Alder Point in sec. 31, T. 3 S., R. 6 E. The deposit consists of an exposure of manganese oxide of medium-grade ore, which presumably contains 20 to 25 percent manganese. The prospect has not been developed.

No. 74. Salt Creek Claim. (By W. G. Pierce, August 9, 1941.) The Salt Creek claim is half a mile off the road up Salt Creek in SW¼ sec. 18, T. 30 N., R. 11 W. The deposit was located by Robert S. and Harriet Hinch on March 14, 1940. It is 3 miles southeast of Peanut and 65 miles from Red Bluff. Development consists of excavations around a block of carbonate ore 10 feet long and 5 feet wide. The block has been unearthed to a depth of 2 feet. The ore bed probably extends 10 feet into the hill. The ore resembles the ore at the Manganese Queen mine (Trinity

61), but it lies in metasediments instead of in greenstone. No real chert was seen, but some greenstone stringers are present. The grade of the ore is estimated to be 35 percent manganese. The quality of the ore suggests that further exploration might bring to light additional ore, but if the ore is similar to the Manganese Queen ore, the carbonate may pass into rhodonite along the strike.

Nos. 75 and 76. Salt Creek No. 2 and No. 3 Claims. (By W. G. Pierce, August 9, 1941.) The Salt Creek No. 2 claim is in the NW¼ sec. 19, T. 30 N., R. 11 W., about 3 miles southwest of Peanut. It was located by Robert S. Hinch. The deposit consists of manganese-stained shale. No chert is present. The strike is N. 45° W., and dip 35° NE. The deposit is of little value.

The Salt Creek No. 3 claim is in the same section as Salt Creek No. 2. It was located by Robert S., Harriet, and Ray Hinch on March 27, 1941. The deposit consists of manganese-stained chert 15 feet in width. The strike is northwest and the dip 35° NE. The grade of ore is less than 2 percent manganese.

No. 77. Schoolhouse No. 1 Claim. (By Parker D. Trask and Frank S. Simons, April 8, 1942.) The Schoolhouse No. 1 claim is located at an altitude of 3,000 feet on the William P. White Estate, 0.3 mile from the road that leads to Alder Point in the NE¼ sec. 9, T. 4 S., R. 6 E. It is under lease to Rae F. Helmke. One cut 10 by 4 feet has been opened. The deposit consists of a mass of recrystallized chert, which grades downward into manganiferous chert. The ore body is 10 feet long and 1 foot wide. Fissures in the chert are lined with manganese oxide. The grade of the ore is estimated to be less than 10 percent.

Nos. 78 and 79. Shell View No. 1 and No. 2 Prospects. (By Parker D. Trask and Frank S. Simons, April 8, 1942.) The Shell View claims No. 1 and No. 2 are at an altitude of about 2,500 feet on the William P. White Estate in the NW¼ sec. 16, T. 4 S., R. 6 E., about 10 miles from Alder Point. No. 1 is located on the west side of a deep canyon, and No. 2 on the east side. The prospects are under lease to Rae F. Helmke and A. Crossman of Alder Point. The deposits, when visited in April 1942, had been developed very little, but during the summer of 1942 they were opened and the ore was shipped to the Metals Reserve Company in Stockton from deposit No. 2, and from a new deposit called Shell View No. 3 (Trinity 80). The amount that was shipped has not been ascertained. A road has since been built to the deposits.

Deposit No. 1 consists of an inclusion of thin-bedded manganiferous chert in a body of greenstone. The ore body is about 10 feet long and 1 foot wide, and consists mainly of bementite, which is estimated to contain 15 percent manganese.

Shell View No. 2 consists of a body of rhodochrosite, rhodonite, bementite, and perhaps inesite, lying in thin-bedded buff chert. The strike is northwest and the dip 55° NE. The ore body is exposed for at least 40 feet on the face of the canyon wall, and has an average thickness of 3 feet. Mr. Helmke says it is more than 5 feet thick at the lower end. The ore body is clearly a bedded deposit in chert, but it has evidently been altered hydrothermally, as is suggested by the presence of rhodonite, inesite (?), and of veins of rhodochrosite. The rhodonite seems to have replaced primary rhodochrosite, but the rhodonite in turn is cut by late veins of rhodochrosite. In places stringers of greenstone cut the ore. The average grade of the ore is estimated to be 35 percent manganese.

No. 80. Shell View No. 3 Deposit. (From files of U. S. Geological Survey, 1942.) The Shell View No. 3 deposit is on the White Ranch, 10 miles from Alder Point in sec. 17, T. 4 S., R. 6 E., a short distance west of the Shell View Nos. 1 and 2 deposits (Trinity 78 and 79). The property is under lease to Rae F. Helmke of Alder Point. The ore body consists of a bed striking N. 5° E. A trench exposes high-grade ore similar in character to the ore in the Shell View No. 2 deposit. Subsequent to 1942, the Shell View No. 3 deposit was opened and ore was shipped to the Metals Reserve Corporation.

No. 81. Skaggs Deposits (Wildwood and Dubakella King). (By Spangler Ricker, 1941.) The Skaggs deposits are near Dubakella Mountain in sec. 24 (?), T. 29 N., R 11 W., 4 miles from a road, about 60 miles from Red Bluff, the nearest rail point. They were located by Carol Skaggs of Cottonwood. The deposits are in chert, which strikes N. 60° W., and dips vertically. The outcrop is 200 feet in length and 4 feet in thickness. Three representative samples taken from different parts of the ore body assayed 8.7, 11.2, and 17.1 percent manganese, respectively. Rhodonite is regarded as the primary mineral, but none was seen. As this deposit is located in a region in which considerable rhodonite is found, the deposit probably is not of great value.

No. 82. Snow Camp Claims. (By Parker D. Trask and Ivan F. Wilson, July 1941.) The two Snow Camp claims were located on August 12, 1940, by Clarence A. Patton and Willis H. Patton of Hayfork. They are in SE$\frac{1}{4}$ sec. 27, T. 2 N., R. 7 E., at an altitude of 4,600 feet, 0.3 mile north of the road to Limedyke Lookout. They are on an abandoned road, 20 miles from Hayfork and 85 miles from the railroad at Redding. Two small pits 3 feet deep have been opened.

The manganese is in a belt of red and purple thin-bedded chert 600 feet in width and at least 2,500 feet in length. The chert strikes northwest and is nearly vertical. The chert is bounded by a basic plutonic rock (greenstone) on each side and seemingly is a roof pendant in this plutonic body. The outcrop is along the strike of similar bodies to the southeast. The chert is coated with films of manganese. A large amount of rock, estimated to contain between 1 and 2 percent manganese, is present. Higher-grade ore is found in a few small pockets, but it is doubtful whether or not more than 100 tons containing 20 percent manganese can be mined. The ore is oxidized to a depth of 3 feet. The primary ore is mainly manganiferous chert, but some rhodonite was seen.

No. 83. Source No. 1 Prospect. (By Frank S. Simons, April 8, 1942.) The Source No. 1 prospect is located at an altitude of more than 3,000 feet on the William P. White Ranch, 1 mile from the road, 8 miles from Alder Point in the SW$\frac{1}{4}$ sec. 5, T. 4 S., R. 6 E. The prospect has been leased to Rae F. Helmke. One pit has been dug. The deposit consists of thin films of manganese oxide on shaly chert. The grade is estimated to be less than 10 percent manganese. The low grade combined with the small size makes the deposit unpromising.

No. 84. Spider Claim (Caudwell). (By Frank S. Simons and S. C. Creasey, August 1941.) The Spider manganese claim is in the NE$\frac{1}{4}$ sec. 20, T. 28 N., R. 11 W., 7 miles in air line south of Peanut, 65 miles from Red Bluff. The claim is in the name of W. O. Friend. The prospect is 3 miles by fair trail from the end of the nearest road and is at an altitude of about 4,180 feet, 500 feet above and 1 mile west of the point where the trail crosses Prospect Creek.

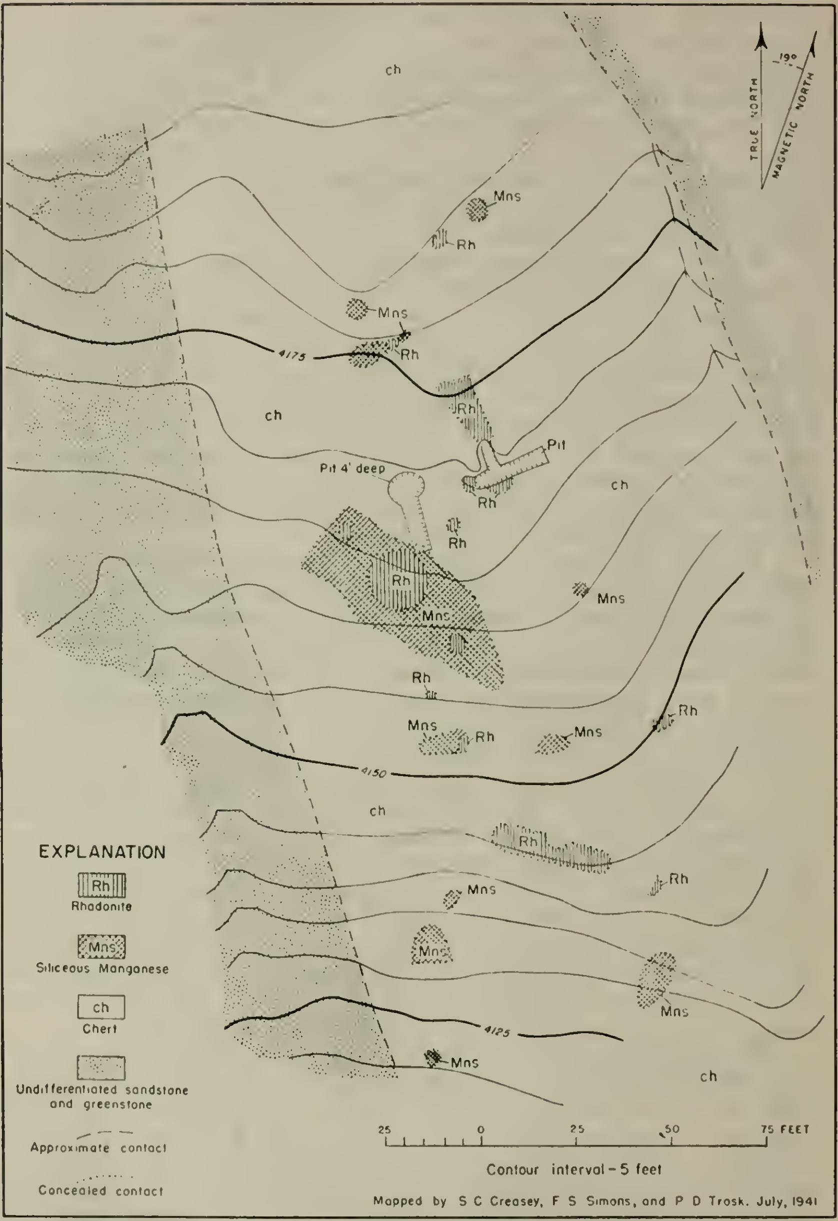
TRUE NORTH
MAGNETIC NORTH
19°
ch
Mns
Rh
4175
Pit
Pit 4' deep
4150
4125
EXPLANATION
Rh
Rhodonite
Mns
Siliceous Manganese
ch
Chert
Undifferentiated sandstone and greenstone
Approximate contact
Concealed contact
25 0 25 50 75 FEET
Contour interval – 5 feet
Mapped by S C Creasey, F S Simons, and P D Trosk. July, 1941

FIGURE 12. Geologic and topographic map of the Spider claim, Trinity County, California.

The mineralized rock of the area is a white and gray chert, striking N. 35° W., and probably dipping steeply to the northeast. The chert body is 150 feet wide. The adjoining country rock is principally sandstone and greenstone. The west contact of the chert is against greenstone. About 200 feet north of the northwesternmost outcrop of chert is a prominent exposure of gray limestone, 200 feet long and with a maximum width of 60 feet. The limestone strikes N. 45° W., and dips 60° NE. It is only slightly recrystallized and the sandstone with which it is in contact shows signs of alteration. The limestone is traversed by a fine network of quartz veins, and is locally siliceous.

The rock along the east contact of the chert is largely brown sandstone, in places partially recrystallized and in places resembling the greenstone. Diorite crops out 400 feet north of the main ore body.

Four types of manganese are present: (1) manganese oxide; (2) rhodochrosite, commonly coated with a film of black oxide; (3) siliceous manganese in which manganese oxide is mixed in small quantities; and (4) chert stained with manganese oxide. The principal ore body is 6.5 feet wide and 31 feet long (fig. 12). Three representative samples from this body gave 22.2, 17.8, and 19.3 percent manganese, respectively. The principal ore mineral is rhodochrosite, but in places considerable rhodonite and bementite are present. The mineral relationships are similar to those in the Manganese Queen mine (Trinity 61), 10 miles to the north. If a market for siliceous ore is found, the Spider deposit should be worth developing.

No. 85. Stockton Deposits. (By Parker D. Trask, June 17, 1941.) The Stockton deposits are at an altitude of 2,700 feet upon land owned by Warren Stockton of Zenia, in the SW¼ sec. 9, T. 3 S., R. 6 E. They are 1 mile from a road and about 10 miles from the railroad at Alder Point. Development consists of a few shallow cuts and trenches. The ore is found in several patches over an area of 200 by 300 feet on the steep slope of the mountain. The rocks in the general region are broken by faults and in places have slumped, but at the locality of the manganese deposits they seem in place. The largest ore bed is 30 feet long and 5 feet wide. The strike is northwest and the dip nearly vertical. The ore consists of stockwork similar to that in the Ladd mine (San Joaquin 5). The grade is estimated to be 20 percent manganese. One assayed 9.2 percent manganese.

No. 86. Summit No. 1 Deposit. (By Frank S. Simons, April 8, 1942.) The Summit No. 1 deposit is located at an altitude of more than 3,000 feet in the SE¼ sec. 6, T. 4 S., R. 6 E., about 1 mile from a road and 8 miles from Alder Point, the nearest rail point. It is on the William P. White Estate. One cut has been dug. The deposit consists of films of manganese on low-grade manganiferous chert. The average grade is estimated to be 15 percent. The size of the ore body is 6 by 10 feet.

No. 87. Sylvester-Wilson Claim. (By R. R. Morse, August 5, 1918.) Near the summit of the Hay Fork, Prospect Creek divide, in the S½ sec. 34, T. 29 N., R. 11 W., a small deposit of manganese "ore" has been mined out, the "ore" remaining on the dump at the present time. Soft black manganese oxides form a matrix about fragments of dark-green chert. The chert dips steeply to the northeast. Above the chert is a thin layer of clay with textures suggestive of altered tuffaceous rocks, followed above by dark sericitic slate. The grade of the ore on the dump is about 20 percent manganese. The owners are Joseph Sylvester and James Wilson.

No. 88. Tan Oak No. 1. (By Parker D. Trask, April 7, 1942.) The Tan Oak No. 1 deposit lies half a mile south of the Bucking Camp No. 1 prospects (Trinity 26 and 27) on the Rohrbough Ranch at an altitude of about 2,500 feet in the SW¼ sec. 32, T. 3 W., R. 6 E., approximately 0.8 mile from the road and 8 miles from Alder Point, the nearest rail point. Development consists of a trench around the ore body. The deposit is composed of a block of fairly high grade oxide, 10 feet long and 5 feet wide embedded in soil. Presumably it is float, but the large size suggests the presence of ore in place nearby. The deposit swells from a width of 3 feet at the surface to 6 feet at a depth of 4 feet and then begins to taper. The long direction trends N. 15° E. The grade was estimated to be about 40 percent manganese. The relatively large size and high grade of the deposit indicates the desirability of additional exploration, though the locality is one of landslides and the block of ore may be far from its original setting.

No. 89. The Cliff Deposit. (By W. G. Pierce, August 19, 1941.) The Cliff deposit is in the NE¼ sec. 22, T. 31 N., R. 11 W., on the east side of Hayfork Creek, about 2 miles north of Peanut, and 70 miles from Redding. It was located by Sadie I. Blake and Hattie Taylor on September 9, 1940. The claim consists of a big cliff of chert striking N. 10° E., and dipping 55° SE. Several surface cuts were made by William Vance and associates, but no ore was found, except manganese stains on the chert.

No. 90. The Manganese Claim. (By Ivan F. Wilson, July 22, 1941.) The Manganese claim is in the SE¼ sec. 4, T. 1 S., R. 8 E. It is 0.3 mile north of the Forest Glen-Hayfork highway, 500 feet east of the Long Gulch trail. The nearest railroad is 70 miles distant. The claim was located by T. J. Montgomery of Hayfork, August 4, 1940. An ore body 3 feet thick is exposed in open cuts for a length of 6 feet and a depth of 6 feet. It consists of partly to completely oxidized pink, finely crystalline rhodonite and brown manganese chert. Some fairly high grade black oxide ore has been exposed which probably contains 40 percent manganese. Mr. Montgomery quoted assays of 46, 44, and 40 percent manganese.

The ore is enclosed in cherty shale, which strikes N. 65° W., and dips 50° NE. The ore body is cut off on the northwest by a fault which strikes N. 10° E. To the south the ore runs into massive white and gray chert cut by quartz veins. This chert contains no manganese. The contact to the south is obscure, but as the ore body is completely surrounded by trenches to the west, north, and east, there is no hope of any extension in these directions. The chert is bordered by sandstone, greenstone, and serpentine.

No. 91. Twisted Oak No. 1. (By Parker D. Trask and Frank S. Simons, April 8, 1942.) The Twisted Oak No. 1 deposit is in the bottom of a basin characterized by landslides. It is 0.7 mile from a road and 10 miles from Alder Point at an altitude of 2,500 feet in the SW¼ sec 9, T. 4 S., R. 6 E. It is under lease to Rae F. Helmke of Alder Point. Development consists of a trench which exposes a bed of fairly high grade oxide in red chert. The chert can be traced for 60 feet, the ore body for only 10 feet. The average grade is estimated to be 35 percent manganese. If the ore bed were wider or were more extensive, it might be profitable to prospect this deposit because of the good grade of the ore.

No. 92. Two Sugar Pines. (By W. G. Pierce, August 19, 1941.) The Two Sugar Pines claim is in the SE¼ sec. 20, T. 31 N., R. 12 W., on Tule Creek about 0.8 mile from the road, 8 miles southwest of Hayfork. The deposit was located by Georgie L. Crews and Hattie S. Taylor on November 16, 1940. The claim was leased to Vance and Barnes shortly thereafter. Development work consists of a few cuts. The ore is composed of a body of manganiferous chert 185 feet long and 60 feet wide. It strikes northeast and dips 80° SE. The grade seems to diminish toward both ends, but nowhere is it over 10 percent manganese. A representative sample from the deposit contained 2.19 percent manganese. The chert is associated with serpentine and greenstone, and is similar to the Carr claims (Trinity 28) a short distance to the west. The tonnage of ore is large, probably in excess of 10,000 tons, but as the grade is less than 5 percent, the deposit is of little value.

No. 93. Vance Claims (Ned, Julia, Vesta, Chester, Billbub, Ann, and Satterlee). (By Parker D. Trask, November 1942.) A series of claims, taken out by Wm. Vance, is said to surround the Manganese Queen claim (Trinity 61). Presumably they are located in secs. 25, 26, 35, and 36, T. 30 N., R. 12 W. The location notices for these claims were not found. The rock in this area is mainly greenstone. No indication of manganese ore was seen.

No. 94. Wagon No. 1 Prospect. (By Parker D. Trask and Frank S. Simons, April 8, 1942.) The Wagon No. 1 prospect is located on the Rohrbough Ranch at an altitude of about 3,000 feet in SE¼ sec. 6, T. 4 S., R. 6 E. It is 0.4 mile from a road and 8 miles from Alder Point. The deposit is under lease to Rae F. Helmke. It lies in badly slumped country on the slope into the Eel River. One bulldozer cut exposes a zone of stockwork ore 3 feet wide in red chert. The strike is east and the dip is vertical. A similar ore body is found in the cut 100 yards to the southeast. The grade of ore is estimated to be about 20 percent manganese.

No. 95. Wagon No. 2 Prospect. (From files of U. S. Geological Survey, 1942.) The Wagon No. 2 claim is on the Rohrbough Ranch, 0.3 mile from the road in sec. 2, T. 4 S., R. 6 E. It is leased to Rae F. Helmke of Alder Point. Development consists of two small cuts which expose a large body of oxide ore. A representative assay gave 34 percent manganese and 29 percent silica.

Nos. 96 and 97. Ware Deposits No. 1 and No. 2. (By Charles R. Warren, August 26, 1941.) Two manganese deposits were visited upon land owned by Philip Ware of Zenia. They are located on the north side of Mud Creek, about 2 miles apart. Deposit 1 is in the SE¼ sec. 18, T. 3 S., R. 6 E., and deposit No. 2 is in the SE¼ sec. 8 of the same township. The second deposit consists only of stains of manganese on red and white chert over an area 30 feet long and 5 feet wide. Deposit No. 1, however, is composed of stockwork oxide ore, estimated to contain between 20 and 30 percent manganese. It is best exposed in an old cut now partly caved. In this cut a bed 1 foot thick crops out for a distance of 2 feet. Mr. Arthur Grossman said that when the cut was first dug, the bed was 6 to 8 feet wide. The strike of the bed in this cut is N. 60° W., and the dip 76° SW.; but 10 feet northeast the dip is 75° NE. About 100 feet down the hill another bed 1.5 to 2 feet thick is found in an anticline that plunges 55° down the hill. The surface of the ground below is covered by manganese float which presumably came from this ore bed. The strike length of the ore in this place is 35 feet. As manganiferous chert is found at intervals for 2 miles to the west, other small deposits of manganese may be present.

No. 98. Weed (Ward) Prospect. (By R. R. Morse, August 5, 1918.) A claim owned by Frank Weed of Knob, is located at the head of the main branch of Hayfork Creek, about 1 mile due south of the upper end of the Union Chrome Company's road, in the vicinity of sec. 34, T. 29 N., R. 11 W. Prominent cliffs of dense flinty manganese-stained chert dipping steeply northeast occur here, northwest of a wide belt of chrome-bearing serpentine, which occupies the summit region south of Wildwood.

The same mineral association occurs here as on the Foss claims (Trinity 40); that is, psilomelane and pyrolusite in thin bands, and psilomelane in thin films on the chert and in intersecting veinlets cutting the chert. Fresh specimens of the chert are light gray, faintly banded with narrow dark streaks, and carry a little manganese oxide. Fracture planes are coated with iron oxide and manganese oxide.

No. 99. White Deposit (Maple Springs). By Parker D. Trask, April 8, 1942.) The White deposit is situated on the William P. White Estate on the southwest slope of Neafus Peak at an altitude of about 3,000 feet in the NW¼ sec. 8, T. 4 S., R. 6 E. The deposit is 1 mile from the road from Alder Point to Hoaglin, and 11 miles from Alder Point. Development consists of two cuts dug during the last war. One of these is 50 feet in length, 10 feet in width, and 8 feet deep. No work has been done recently.

The ore is in a block of massive manganiferous chert approximately 100 feet in diameter. The chert is partly recrystallized to quartz and appears to be altered hydrothermally. The manganese is found mainly in a zone 50 feet long and 10 feet wide, along the course of the larger trench. The strike is northwest, but the dip is unknown, perhaps 70° NE. At the surface of the ground the manganese is converted to oxides, and ore perhaps as high as 40 percent in manganese may have been present before the cut was dug, but the oxides now give way to primary manganese silicate, probably bementite, within 5 feet of the surface. The deposits are in an area of landslides and probably do not extend far beyond their present outcrop.

No. 100. Whiteman Claim. (By Ivan F. Wilson, August 4, 1941.) The Whiteman claim is 900 feet north of the Gool No. 2 claim (Trinity 42) in the SW¼ sec. 30, T. 1 N., R. 8 E. The claim was located September 24, 1940, by J. W. Patton of Peanut. The claim contains three separate bodies of manganiferous red and purple chert, of a type similar to that of the Gool No. 2. The three bodies are, respectively, 250 feet long, 20 feet thick; 80 feet long, 25 feet thick; and 50 feet long, 20 feet thick. The strike of the largest body is N. 60° E. at the northeast end, and N. 45° W. at the southwest end. The dip is 45° E. The rocks adjacent to the chert bodies are greenstone and serpentine. One small prospect pit is located on the property. The average grade is about 5 percent manganese. Manganese oxide occurs mostly as stains and coatings, but to some extent penetrates the chert. Presumably it is derived from manganiferous chert, though it may have come from rhodonite, as a little pink rhodonite was seen.

No. 101. White Oak Prospect. (By Frank S. Simons and Max D. Crittenden, Jr., July 15, 1942.) The White Oak prospect is in the NE¼ sec. 13, T. 2 S., R. 8 E., half a mile east of the Hayfork trail from the Mad River along Barnes Creek. It was located by Robert Hill and Ann Anderson on May 3, 1942, and extends 750 feet north and south from the discovery monument. The country rock consists of faulted and folded thin-bedded shaly chert. Near the discovery monument, a large block of partly oxidized manganese carbonate ore was found. This block consisted of dark reddish-black ore believed to be a mixture of hausmannite and silica. The primary hausmannite (?) has been replaced by gray carbonate and by veins of pink rhodochrosite and native copper. The block may be a faulted remnant of a more extensive ore body, or less likely, a piece of float. In any case, no more ore has been found, and the lack of outcrops in the vicinity makes it probable that none is present.

No. 102. Wood Deposit. (By Parker D. Trask, June 16, 1941.) The Wood deposit is situated on the Rohrbough Ranch at an altitude of about 3,000 feet in the SE¼ sec. 31, T. 3 S., R. 6 E. In June 1941 it was reportedly leased to E. P. (Sam) Wood of Harris. No development has been done. The deposit consists of siliceous manganese oxide in a mass of red chert which strikes N. 45° E., and dips nearly vertically. The ore body is about 1 foot thick and 10 feet long. The grade is estimated to be 15 percent manganese.

No. 103. Woods Claim. (By W. G. Pierce, August 19, 1941.) The Woods claim is in the northeast corner of sec. 27, T. 31 N., R. 11 W. It is said to be owned by a Mrs. Wood. The claim was not found, but the most likely source for manganese in the general vicinity is a body of chert. No manganese ore minerals were seen in this chert.

Nos. 104 and 105. Wool Mountain No. 1 and No. 2 Claims. (By Parker D. Trask and Frank S. Simons, April 7, 1942.) The Wool Mountain claims are on the Rohrbough Ranch half a mile from a road, 7 miles from Alder Point in the NE¼ sec. 31, T. 3 S., R. 6 E., at an altitude of about 3,000 feet. They are under lease to Rae F. Helmke.

Wool Mountain No. 1 is 0.3 mile west of Bucking Camp No. 1 (Trinity 26). A trench 6 feet deep and 10 feet wide has been bulldozed for a distance of 125 feet. This cut exposes an ore body 6 feet wide and 60 feet long in thin-bedded red chert. The strike is N. 60° W., and the dip 80° to 85° S. The stockwork ore is similar to that at the Ladd mine (San Joaquin 5). The grade is believed to be about 20 percent manganese.

Wool Mountain No. 2 lies 700 feet southwest of No. 1. The ore is better grade than in No. 1, running perhaps 35 percent. A bulldozed trench exposes a bed of ore 3 feet thick, 3 feet deep, and 12 feet long. This bed is in thin-bedded red chert which strikes N. 40° E., about 90° to the strike at Wool Mountain No. 1. The structure is complicated by folding, faulting, and slumping. If further prospecting is done the ore may be found to have only a limited extent.

TULARE COUNTY

No. 1. Barbour Prospect. (By Ivan F. Wilson, September 27, 1942.) The Barbour prospect, owned by Frank Barbour of Stockton during World War I, is located on the Flying T. Ranch, now owned by Ben K. Stroud of Springville. The prospect is 1 mile west of Milo in sec. 33, T. 19 S., R. 29 E. It is on a low hill 65 feet south of the road, 0.6

mile east of the Flying T. ranch house. The nearest shipping point is Springville, 7 miles south. Development consists of a caved pit 10 feet in diameter, and 5 feet deep. On the west side of the pit is a quartz vein 1.5 feet thick, consisting of clear glassy quartz coated by soft black sooty impure pyrolusite. The quartz is also stained with limonite and hematite, which may have been derived from sulphides. This deposit is in a large area of granitic rocks.

No. 2. Cole Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 91, 1918.) A prospect owned by R. D. Cole of Lindsay is 2 miles northeast of Lindsay in sec. 32, T. 29 S., R. 27 E., at an altitude of 680 feet. A siliceous ledge of manganiferous iron ore 25 feet wide and 100 feet long is between two beds of jasper and slate. These beds strike N. 20° W., and dip 75° SW. Selected specimens assay 35 percent manganese, but the average is about 18 percent manganese. Development consists of a shaft 30 feet deep and an open cut, exposing about 500 tons of mixed ore.

No. 3. Dry Creek. (Modified slightly from original description in California Div. Mines Rept. 26, p. 454, 1930.) Manganese ore is found in several places for 15 miles along Dry Creek near Badger, mainly in the vicinity of sec. 23, T. 15 S., R. 27 E.

No. 4. Gill Ranch Prospect. (From files of U. S. Geological Survey, 1942.) The Gill Ranch prospect is located 10 miles southeast of Lindsay, probably in T. 20 S., R. 28 E. It is said to be owned by Z. E. Pope. The ore body consists of a mixture of rhodonite and oxide. A representative sample assayed 14.9 percent manganese, 2.20 percent iron, and 69.78 percent silica.

No. 5. O'Kelly Prospect. (By Spangler Ricker, 1942.) A prospect controlled by L. W. O'Kelly is located on Cronk's Ranch, 13 miles east of Porterville, probably in T. 21 S., R. 29 E. The ore consists of stains of manganese oxide on metamorphic rocks. The grade is less than 10 percent manganese.

TUOLUMNE COUNTY

No. 1. Flaming Arrow Prospect. (From files of U. S. Geological Survey 1942.) The Flaming Arrow prospect is 12 miles northwest of Columbia in sec. 21, T. 3 N., R. 15 E., and is controlled by Nathan Williams of Columbia. The deposit consists of a mixture of rhodonite and manganese oxides in metasediments. The beds strike east. The grade ranges from 13 to 17 percent manganese, 1.3 to 1.7 percent iron, and 75 to 80 percent silica.

No. 2. Hog Mountain Prospect. (By N. L. Taliaferro, July 1, 1918.) Several manganese claims have been located in sec. 5, T. 1 S., R. 15 E., on Hog Mountain, by Charles Sutton of Jacksonville. The main outcrop is on the steep southern slope of Hog Mountain at an altitude of 1,900 feet and about 900 feet above Tuolumne River, 7.5 miles northeast of Jacksonville and 10 miles southeast of Jamestown.

The rocks exposed on this part of Hog Mountain are predominantly quartz schist, quartz-mica schist, and quartzite of the Calaveras formation, probably in the upper part of the formation.

These schistose rocks have been subjected to both regional and contact metamorphism. An aegirine metadiorite mass is exposed less than 1.5 miles to the northwest and it is probable that this partly deroofed mass which apparently widens rapidly in depth, lies not far below the surface at this point. The regional metamorphism has folded the beds into sharp, closely compressed isoclinal folds and has probably caused a certain amount of crystallization and the development of new minerals, such as sericite, chlorite, etc. It is not easy to distinguish between the effects of the contact and regional metamorphism in the schist but the decided coarsening of the grain is apparently due to the heating effect of the igneous mass. No contact minerals were noted. On account of this double metamorphism, the original nature of the schist is uncertain. However, the minerals directly associated with the manganiferous schist show certain definite characters that indicate their original nature. Thin-bedded quartzite is separated by thin partings of sericite. A few more massive lenses of fine-grained quartzite are present, and it is with these massive lenses of quartzite that the manganese is usually associated. The quartzite is remarkably pure except for the presence of minute particles of dusty limonite and flakes of sericite scattered throughout. In places where there has been little secondary crystallization, the rock is exceedingly dense and compact. The more massive lenses especially, still show areas of chalcedonic silica, which have not been wholly crystallized into quartz. The available evidence indicates that the schist is the metamorphic equivalent of thin-bedded chert with a few more massive lenses of chert.

The manganese is associated with the more massive metachert lenses. Dusty black manganese oxide occurs as stains and as finely disseminated particles throughout the massive metachert at several horizons. The largest chert body varies from 8 to 12 feet in width and can be traced for more than 100 feet. Several other lenses are 2 to 4 feet in width. Two samples taken across the main lens were mixed and assayed, with the following results: manganese, 14.6 percent; insoluble, 69.9 percent.

Ore of higher grade could not be obtained even by careful hand sorting. No trace of the primary minerals could be found. However, as this peculiar type of dusty ore is the oxidation product of manganese garnet in Calaveras County, this mineral may lie below the oxidized zone, which should not extend to any great depth.

No ore has ever been shipped from this deposit. In fact, no development has been done. There is no ore of shipping grade in sight nor could any be obtained by hand sorting. Although there are fully 1,200 to 1,500 tons of 15 percent manganese material in sight the deposit has no present economic value since this type of material is not amenable to concentration.

No. 3. Hughes Mine (Bulldog, Cummings). (By Ivan F. Wilson, September 20, 1942.) The Hughes mine is located 6 miles southwest of Moccasin in sec. 17, T. 2 S., R. 15 E. It is reached by proceeding along the road from Moccasin toward Blanchard for 5.3 miles to the Lebrun Ranch. The mine is about a mile west of the Lebrun Ranch, half a mile from a road on a steep, manzanita covered east slope. During World War I this mine was owned by J. J. and T. M. Hughes. A claim known as the ''Bulldog'' was taken out by F. E. Cummings on this property, on August 2, 1941. Development consists of a series of 6 cuts along the strike of a manganese ore bed over a total length of 280 feet. The largest, near the southwest end, is 20 feet long, 6 to 8 feet wide, and 10 feet deep. The cut farthest to the north is 25 feet long, 5 feet wide, and up to 8 feet deep. The others are similar.

The manganese ore occurs in chert, most of which is thick-bedded and red in color, but some is pale green or white. The chert is enclosed in metatuff (?) and green metavolcanics. These rocks belong to the Amador group. They strike N. 25°-50° E., and dip in general 70° SE.

The ore is mostly hard, brittle psilomelane, and is generally rather cherty. Most of it probably contains 30 percent manganese, although some might run 40 percent manganese. At the northernmost cut the ore is 6 inches thick where exposed on the face of the cut. The shallow cuts southwest of this cut reveal up to 2 feet of rather cherty ore. The largest cut to the southwest does not now reveal any ore, except for a narrow stringer 2 inches thick on the northwest wall. Some ore remains on the dump, and most of the ore which was shipped probably came from here. The small southernmost cut reveals a block of psilomelane ore 2 feet wide and 3 feet long, with some patches of pink rhodonite. In 1918, 45 tons of ore was shipped from this property, running 42 percent manganese, 10 percent iron, and 15 percent silica.

No. 4. Jasper Prospect. (By Ivan F. Wilson, September 18, 1942.) The Jasper prospect is half a mile northeast of Keystone in the NE¼ sec. 23, and the NW¼ sec. 24, T. 1 S., R. 13 E. It is owned by E. M. Jasper of Jamestown. The prospect is reached by private roads on the Jasper Ranch. The nearest rail point is Keystone on the Sierra Railroad.

About 0.1 mile north of the Jasper ranch house is a pit 4 by 4 feet, and 4.5 feet deep, in a banded quartzite (probably metachert) cut by quartz veins up to 6 inches thick. Fracture planes are stained with manganese oxide. A zone about 1 foot thick penetrated by manganese oxides lies at the top of the pit. None of the material in this zone contains more than 10 percent manganese. The quartzite or metachert is enclosed in quartz-mica schist, which strikes N. 65° W., and dips 60° NE. A belt of serpentine lies to the northeast.

About half a mile to the west is another pit 4 by 6 feet and 8 feet deep. The rocks exposed here are green metavolcanics or ''greenstone schist.'' They are stained with manganese oxide along fractures. The rocks strike N. 40° W., and dip 70° NE. Nothing was seen on this property which would be likely to provide a commercial source of manganese.

No. 5. Madrid Prospect. (Modified slightly from original description in California Min. Bur. Bull. 76, p. 91, 1918.) A prospect owned by John Madrid of Jamestown, is 2 miles north of Sonora near Brown's Flat, probably in sec. 25, T. 2 N., R. 14 E. Manganese oxide and rhodonite occur in a quartz vein along the contact between porphyry and schist. The mineralized area is 12 feet in width, but the grade of manganese probably is low, as the ore seems mainly to be a surficial coating of oxide.

No. 6. Pedro Prospect (Stonewall). (By Ivan F. Wilson, September 15, 1942.) The Pedro prospect is 2 miles north of Sonora in sec. 25, T. 2 N., R. 14 E. It is on the top of a hill 0.1 mile west of Highway 49, and 0.1 mile south of the junction of Highway 49 with the road to Columbia. It is on property owned by A. L. Pedro of Columbia. No work has been done since World War I. The nearest shipping point is 2 miles south of Sonora. Development consists of a pit 5 feet in diameter, and 6 feet deep, now caved. On a dump by the pit is a ton of manganiferous rock, consisting chiefly of pink rhodonite, coated by black manganese oxides. No large fragments of oxide free from rhodonite were seen.

A manganiferous rock in the bottom of the pit, which probably is not in place, is a rhodonite metachert. It is recrystallized to fine-grained gray quartzite, containing grains of rhodonite scattered between the quartz grains. The size of the block indicates it was derived from a bed at least 1 foot thick and 5 feet long. No manganiferous rock is seen on the surface around the pit. Just north of the pit are prominent exfoliated outcrops of a granitic rock, which are seen to be close to a biotite diorite porphyry, containing saussuritized plagioclase phenocrysts in a fine-grained granitic groundmass, revealing biotite and plagioclase. This prospect is of no commercial value because the manganese is mostly in the form of rhodonite.

No. 7. Schoettgen Prospect (Experimental Mine). (By Ivan F. Wilson, September 17, 1942.) A manganese prospect is located at the Experimental mine (a gold mine) owned by Frank Schoettgen of Columbia. It is 2 miles north-northeast of Columbia in sec. 1, T. 2 N., R. 14 E. The property is reached by proceeding along the road from Columbia toward Italian Bar and American Camp for 1.5 miles, and then turning off to the north at a sign pointing to the Experimental mine. The nearest shipping point is 6 miles to the south, at Sonora.

The manganese occurs in a cut at the mouth of a tunnel in the gold mine. No development has been done specifically for manganese. The tunnel is in gray limestone, which is part of a large belt of limestone in the vicinity of Columbia, belonging to the Calaveras formation. On top of the exposure of limestone in the cut is a superficial deposit of manganese oxide, mixed with iron oxide and clay. The zone of manganese oxide is 2 feet thick. It is overlain by 8 feet of reddish soil containing quartz fragments. The zone of manganese oxide is exposed for a distance of 30 feet in the cut. It shows a banding roughly parallel to the surface slope, which is inclined about 20° E. The zone of manganese oxide is porous and light. The manganese content is low, probably not over 10 percent. This is a superficial deposit which offers little possibilities of providing a commercial source of manganese.

No. 8. West Prospect. (By N. L. Taliaferro, July 3, 1918.) A small amount of partly oxidized rhodonite has been found 1.5 miles west of Tuolumne, a few hundred feet south of the Sonora-Tuolumne road, in sec. 6, T. 1 N., R. 16 E., on land owned by J. H. West of Soulsbyville. The rhodonite occurs as layers or lenses in a small block of siliceous schist of the Calaveras group included in granodiorite near the contact of the granodiorite with schist. Associated with the rhodonite is spessartite, the manganese garnet. Small radiating tuffs of a fibrous manganese amphibole also occur. The intense metamorphism has developed fairly large crystals of rhodonite and garnet. This deposit has no economic importance.

No. 9. Windeler Claims. (By Ivan F. Wilson, September 19, 1942.) The Windeler claims are located in the vicinity of American Camp, in sec. 29, T. 3 N., R. 15 E. Eleven claims have been located by C. R. Windeler of Columbia, Frank E. Knight of Vallejo, and L. R. Knutte of Novato. Apparently no development has been done on the claims. The nearest shipping point is Sonora, 10 miles by road to the south.

Mr. Windeler, who lives at American Camp, took the writer to one of the claims, and showed him specimens from another claim on Willow Creek. They are of a partly oxidized brown manganese garnet (spessartite) rock, such as occurs in many prospects in the Calaveras formation in the foothills of the Sierra Nevada. Material of this sort has no economic value as a source of manganese. The claim shown the writer is in a creek

0.1 mile west of American Camp. The rocks pointed out to the writer as manganese bearing, are biotite and amphibolite schist cut by calcite veins. Only a few manganese stains were seen.

No. 10. Wonder Mine (By Ivan F. Wilson, September 22, 1942.) The Wonder mine is 6.4 miles by road north of Coulterville in the SE¼ sec. 3, T. 2 S., R. 16 E. The mine consists of a series of claims on government land located by Ed Evans and George McGirk, September 6, 1940. Two claim notices were seen on different parts of the property, one called Wonder mine No. 5, and the other unnumbered. Notices state that the property was leased February 15, 1942, to Tom Neally of Patterson. The property was idle when visited. The nearest shipping point is 16 miles to the south, at Bagby.

Four different places, referred to by number, have been worked on this property. Area No. 1 lies on the ridge which is at the west end of the main road across the property. Two shafts have been sunk: one, 11 feet deep; and the other on the top of the hill south of the first shaft, 7 feet deep. Area No. 2 is 500 feet north of area No. 1. Three parallel open cuts transect the strike of the rocks. The maximum depth of the cuts is 3 feet. Area No. 3 is 1,000 feet northwest of area No. 1. One cut is 28 feet long and 6 feet deep. Area No. 4 is 1,000 feet east of area No. 1. Here there is a shaft 14 feet deep and a cut 200 feet north of the shaft. In addition several small cuts are present.

The manganese ore at the Wonder mine is found in a series of stumpy lenses of metachert, cut by quartz veins and enclosed in phyllite or sericite schist belonging to the Calaveras formation. The ore bodies in the different workings appear to be separate lenses. The strike varies from N. 15° to 55° W.; the dip is 75° E. to vertical.

The ore consists of manganese oxides derived partly from brown manganese garnet (spessartite) and partly from pink rhodonite. The garnet produces a crumbly brownish-black ore; the rhodonite in places has formed fairly high-grade black oxide consisting of nodular and botryoidal psilomelane and pyrolusite. Some of the rhodonite occurs in large prismatic crystals up to an inch in length.

In the main shaft at area No. 1 an ore bed is exposed on the south wall. This bed is 5 feet thick at the top, and narrows to 1 foot at the bottom of the shaft. The bed is exposed for a length of 16 feet in the bottom of the shaft. The ore is mostly a rather crumbly, brownish-black oxide derived from manganese garnet. A few blocks of fairly good black oxide ore are on the dump and some ore possibly was shipped from here. The enclosing rocks are soft and crumbly gray sericite schist and look as if they were originally derived from siltstone. The strike is N. 15° W., and the dip 75° E.

The smaller shaft to the south reveals 0.5 to 1 foot of brownish-black ore, probably not of shipping grade. It contains partly oxidized manganese garnet. The strike is N. 55° W., and the dip 80° NE. Stumpy ore lenses are exposed in the outer two of the three cuts in area No. 2, but not in the central cut. In the northwest cut is exposed a lens of ore 5 feet thick at the northwest end. This lens pinches out at the southeast end, in a horizontal distance of 5 feet. Gray phyllite wraps around the lens at the end. The ore is a low-grade brown, partly oxidized garnet ore, cut by quartz veinlets. The strike is N. 50° W., and the dip 80° NE. The southeast cut reveals a lens of ore 2.5 feet thick in the center, wedging out to half a foot at each end. Phyllite wraps around the lens at the ends of the cut. Some blocks of ore reveal partly oxidized pink rhodonite in prismatic crystals up to a quarter inch long.

The open cut at area No. 3 exposes a lens of manganese ore 5 feet wide, which is interbedded in phyllite. The ore is in a fine-grained quartzite cut by quartz veins. The strike is N. 50° W., and the dip is vertical. Specimens of pink rhodonite in prismatic crystals up to an inch long are present. About 20 tons of black oxide ore are piled on the dump, of which perhaps 10 tons are of shipping grade.

In the main shaft at area No. 4 is a bed of shaly, soft, crumbly, brownish-black ore half a foot in thickness on the northeast wall, but which widens out to the southeast. This ore appears to be below shipping grade. It is in a fine-grained gray metachert striking N. 45° W., and dipping 85° NE.

The cut 200 feet north of this shaft exposes a manganiferous lens 2 feet thick for a length of 15 feet. The strike is N. 20° W., and the dip is 85° NE. The ore is a soft, crumbly brownish-black oxide, cut by quartz veinlets. Most of it is probably below shipping grade, perhaps running 30 percent manganese. The other shallow cuts in this vicinity expose a little low-grade brownish-black ore, but most of the cuts are in barren phyllite.

A few truck loads of ore, perhaps 50 tons, were said to have been shipped in 1941, and 8 tons of ore was shipped to the General Dry Battery plant at Patterson during 1942. About 10 tons of ore of shipping grade lies on the dumps. Another 10 tons of ore of shipping grade might be expected from the various cuts. About 15 tons of oxide ore, running perhaps 30 percent manganese, is on the dumps. Possibly 30 tons more could be expected. The appearance of partly oxidized spessartite and rhodonite near the surface make the economic possibilities of this mine poor.

YUBA COUNTY

No. 1. Bean Prospects. (By Ivan F. Wilson, August 1, 1942.) Several prospects east of Clipper Mills were shown the writer by Rufus J. Bean of Clipper Mills. Part of these are in an old hydraulic gold property known as the Kingbird mine and located in sec. 36, T. 20 N., R. 7 E. The mineral rights of this property are owned by a Dr. Martell of Philadelphia. An adjacent prospect to the west owned by Rufus J. Bean is in sec. 2, T. 19 N., R. 7 E. The properties are 0.2 to 0.5 mile east of Clipper Mills, between the highway and Grizzly Creek to the north. The nearest railroad is 28 miles west at Oroville on the Western Pacific Railroad. No development for manganese has been done on the properties.

The Kingbird, an old hydraulic gold placer deposit beneath a lava cap, exposes large boulders of vein quartz and fine-grained quartzite, which probably is metachert. Some of these boulders of metachert contain manganese oxides. There are no minable masses of shipping grade, however.

Along Grizzly Creek to the northwest the metachert is in place. It has been recrystallized to fine-grained white quartzite, and is enclosed in fine-grained gray schist and phyllite, probably of Calaveras age. The metachert contains stains and stringers of manganese oxides, but no material in sight is of economic value.

Assays made by the U. S. Bureau of Mines of samples from this property showed the following results:

Mn	Fe	SiO_2	P
	Percent		
2.0	1.98	89.12	.104
7.6	34.42	29.68	.481

No. 2. Clemens Prospect. (By N. L. Taliaferro, September 9, 1918.) The Clemens prospect is in sec. 29, T. 19 N., R. 7 E., and is said to be controlled by Fred Clemens of Woodleaf. The deposit consists of oxidized rhodonite exposed over an area 15 feet long and 1 foot to 3 feet wide. The manganese content is about 10 percent. The property is undeveloped.

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*Prepared by Beth Collins.

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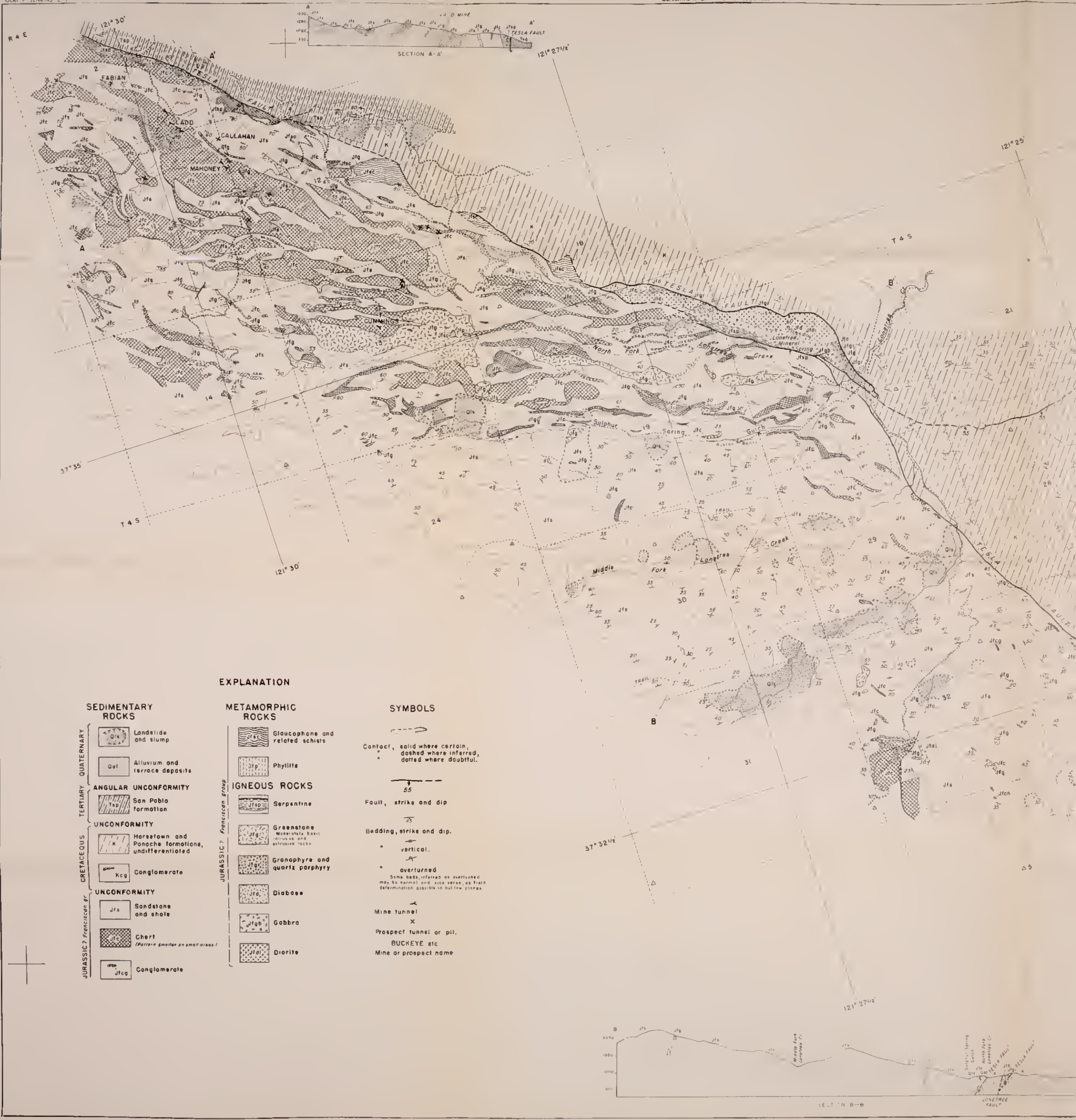
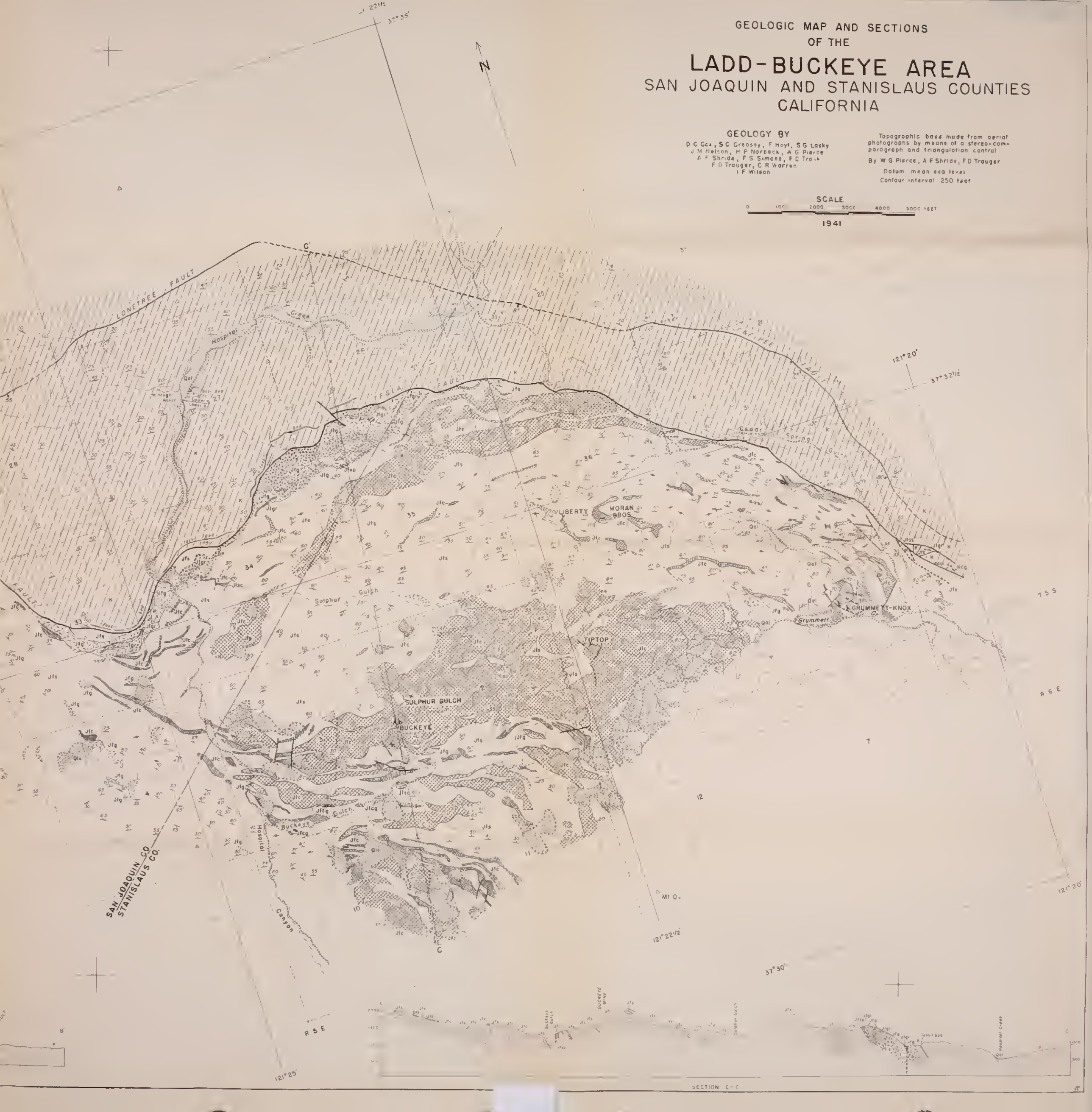

R 4 E
121° 30'
121° 27½'
121° 25'
37° 35'
37° 32½'
T 4 S
SECTION A-A'
TESLA FAULT
A
A'
B
B'
FABIAN
LADD
CALLAHAN
MAHONEY
CUMMINGS
North Fork Lonetree Creek
Lonetree Mineral Spring
Sulphur Spring Gulch
Middle Fork Lonetree Creek
TRAIL
SECTION B-B
LONETREE FAULT
EXPLANATION
SEDIMENTARY ROCKS
QUATERNARY
Qls Landslide and slump
Qal Alluvium and terrace deposits
ANGULAR UNCONFORMITY
TERTIARY
Tsp San Pablo formation
UNCONFORMITY
CRETACEOUS
K Horsetown and Panoche formations, undifferentiated
Kcg Conglomerate
UNCONFORMITY
JURASSIC? Franciscan gr
Jfs Sandstone and shale
Jfc Chert (Pattern smaller on small areas)
Jfcg Conglomerate
METAMORPHIC ROCKS
JURASSIC? Franciscan group
Jfsc Glaucophane and related schists
Jfp Phyllite
IGNEOUS ROCKS
Jfsp Serpentine
Jfg Greenstone Moderately basic intrusive and extrusive rocks
Jfgr Granophyre and quartz porphyry
Jfd Diabase
Jfgb Gabbro
Jfdi Diorite
SYMBOLS
Contact, solid where certain, dashed where inferred, dotted where doubtful.
55
Fault, strike and dip
Bedding, strike and dip.
vertical.
overturned
Some beds, inferred as overturned may be normal and vice versa, as field determination possible in but few places
Mine tunnel
Prospect tunnel or pit.
BUCKEYE etc
Mine or prospect name



GEOLOGIC MAP AND SECTIONS OF THE LADD-BUCKEYE AREA
SAN JOAQUIN AND STANISLAUS COUNTIES CALIFORNIA

GEOLOGY BY

D C Cox, S C Creasey, F Hoyt, S G Lasky
J M Nelson, H P Norbeck, W G Pierce
A F Shride, F S Simons, P D Trask
F D Trauger, C R Warren
I F Wilson

Topographic base made from aerial photographs by means of a stereo-comparograph and triangulation control

By W G Pierce, A F Shride, F D Trauger

Datum mean sea level
Contour interval 250 feet

SCALE

1941

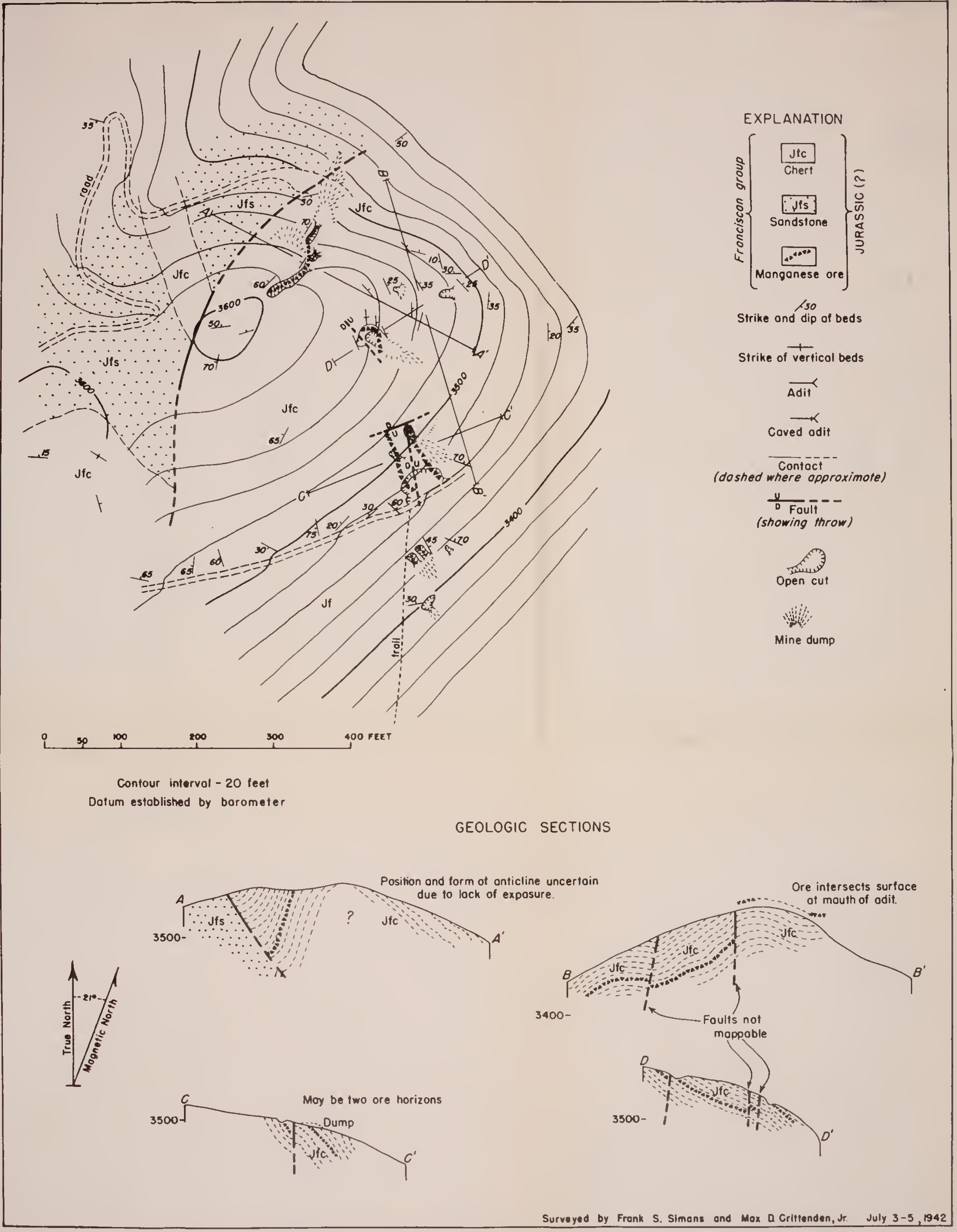
0
1000
2000
3000
4000
5000 FEET
N
121° 22½'
37° 35'
121° 20'
37° 32½'
121° 25'
121° 22½'
37° 30'
LONETREE FAULT
TESLA FAULT
Hospital Creek
Cedar Spring Gulch
Sulphur Gulch
Buckeye Gulch
Grummett Cr.
Hospital Canyon
LIBERTY
MORAN BROS.
GRUMMETT-KNOX
TIPTOP
SULPHUR GULCH
BUCKEYE
SAN JOAQUIN CO.
STANISLAUS CO.
T 5 S
R 6 E
R 5 E
C
C'
K
Jfs
Jfc
Jfg
Jfgr
Qal
Qls
Kcg
Jfcg
MI O.
SECTION C-C'

DIVISION OF MINES
OLAF P. JENKINS, *Chief*

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BULLETIN 152
PLATE 1


EXPLANATION
Jfc
Chert
Jfs
Sandstone
Manganese ore
Franciscan group
JURASSIC (?)
50
Strike and dip of beds
Strike of vertical beds
Adit
Caved adit
Contact
(dashed where approximate)
U
D
Fault
(showing throw)
Open cut
Mine dump
road
trail
Jfc
Jfs
Jf
3600
3500
3400
A
A'
B
B'
C
C'
D
D'
0
50
100
200
300
400 FEET
Contour interval - 20 feet
Datum established by barometer
True North
Magnetic North
21°
GEOLOGIC SECTIONS
Position and form of anticline uncertain due to lack of exposure.
?
3500-
3400-
Ore intersects surface at mouth of adit.
Faults not mappable
May be two ore horizons
Dump

Surveyed by Frank S. Simons and Max D. Crittenden, Jr. July 3-5, 1942

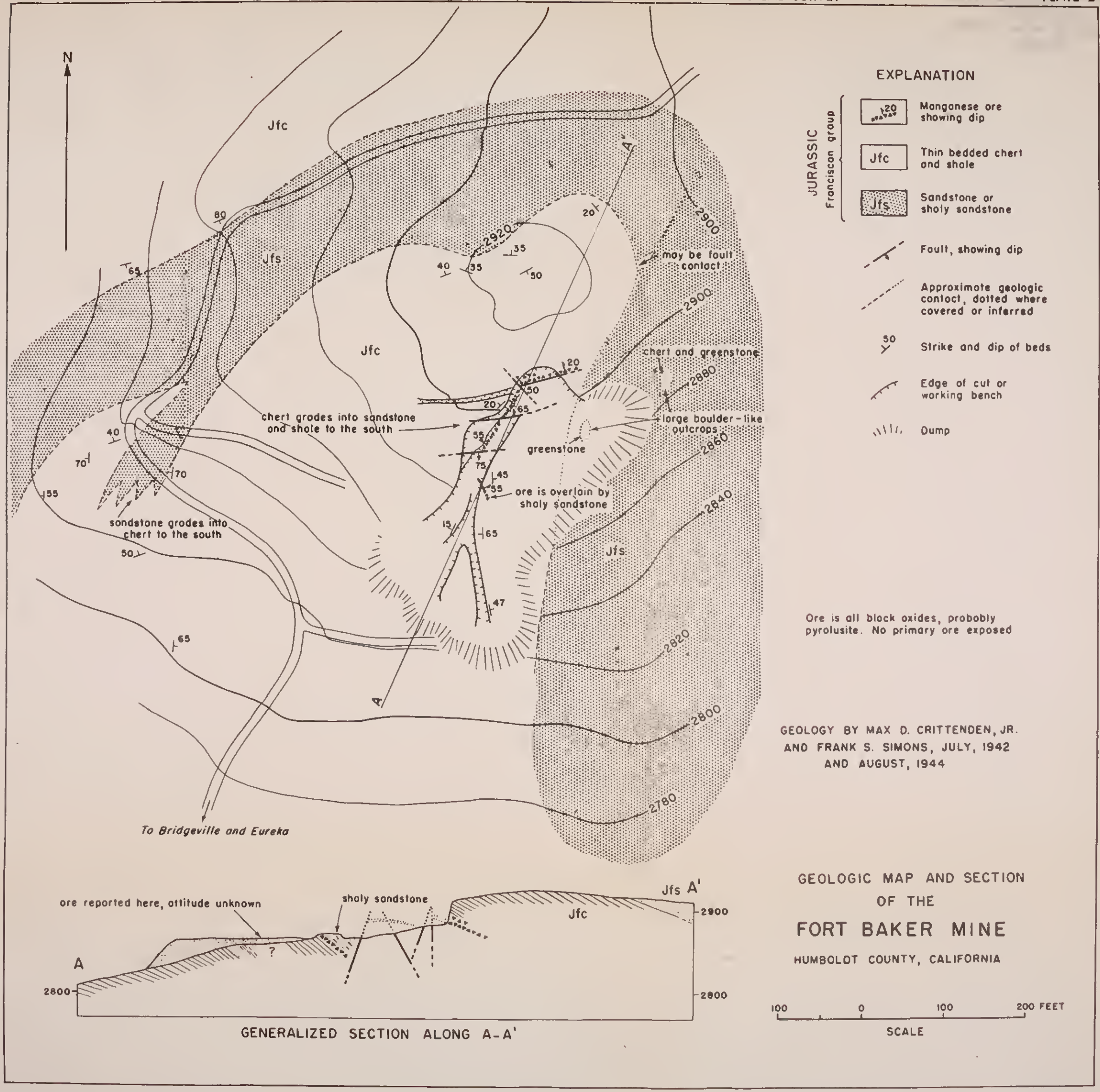
GEOLOGIC MAP AND SECTIONS OF THE CHARLES MOUNTAIN MINE, HUMBOLDT COUNTY, CALIFORNIA

DIVISION OF MINES
OLAF P. JENKINS, *Chief*

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GEOLOGY


N
EXPLANATION
JURASSIC
Franciscan group
Manganese ore showing dip
Jfc
Thin bedded chert and shale
Jfs
Sandstone or shaly sandstone
Fault, showing dip
Approximate geologic contact, dotted where covered or inferred
Strike and dip of beds
Edge of cut or working bench
Dump
Jfc
Jfs
A'
A
2920
2900
2880
2860
2840
2820
2800
2780
may be fault contact
chert and greenstone
large boulder-like outcrops
greenstone
chert grades into sandstone and shale to the south
ore is overlain by shaly sandstone
sandstone grades into chert to the south
To Bridgeville and Eureka
Ore is all block oxides, probably pyrolusite. No primary ore exposed
ore reported here, attitude unknown
shaly sandstone
?
2900
2800
GENERALIZED SECTION ALONG A-A'
100
0
100
200 FEET
SCALE

GEOLOGY BY MAX D. CRITTENDEN, JR.
AND FRANK S. SIMONS, JULY, 1942
AND AUGUST, 1944

GEOLOGIC MAP AND SECTION
OF THE
FORT BAKER MINE
HUMBOLDT COUNTY, CALIFORNIA

GEOLOGY

DIVISION OF MINES
OLAF P JENKINS, CHIEF

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
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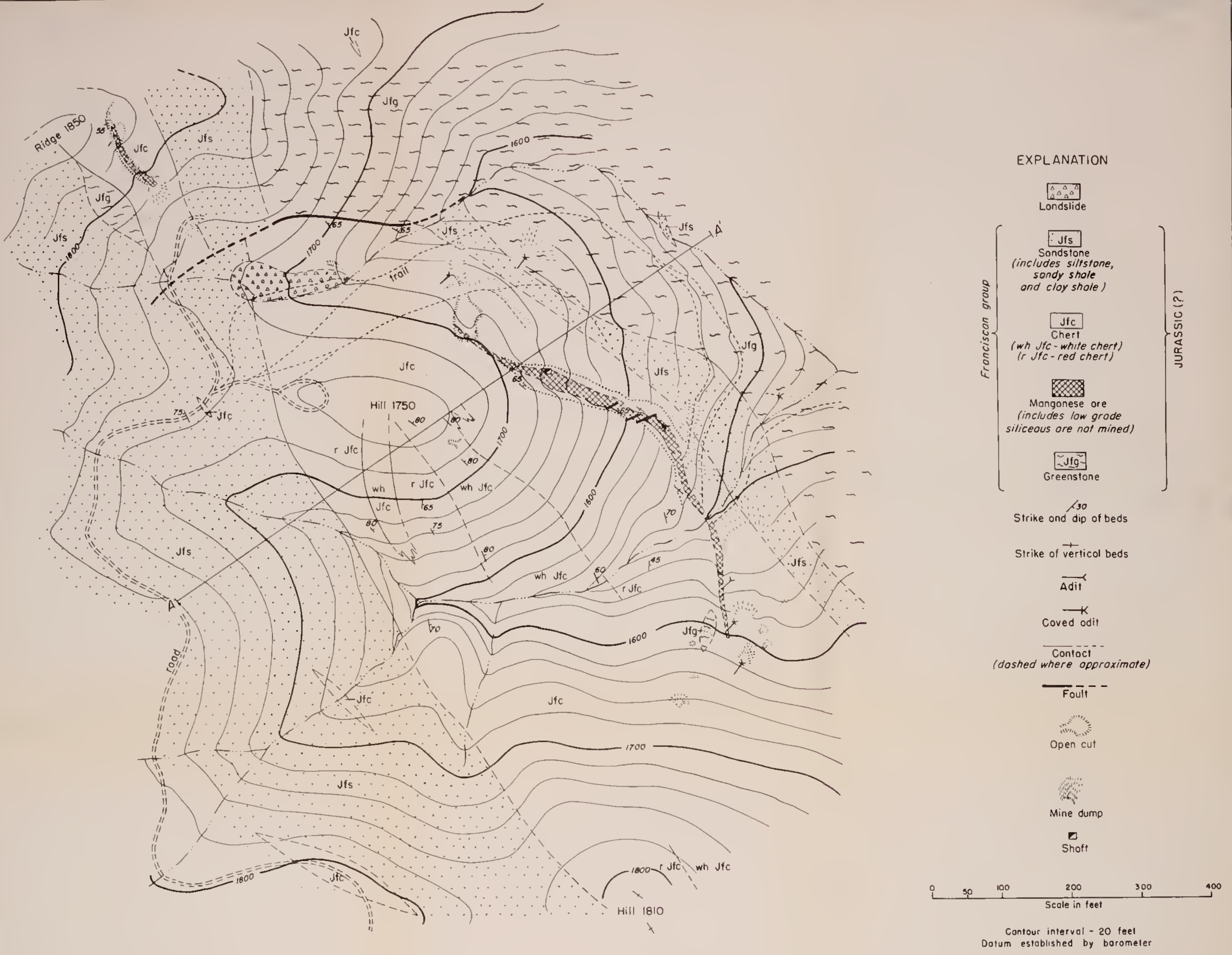
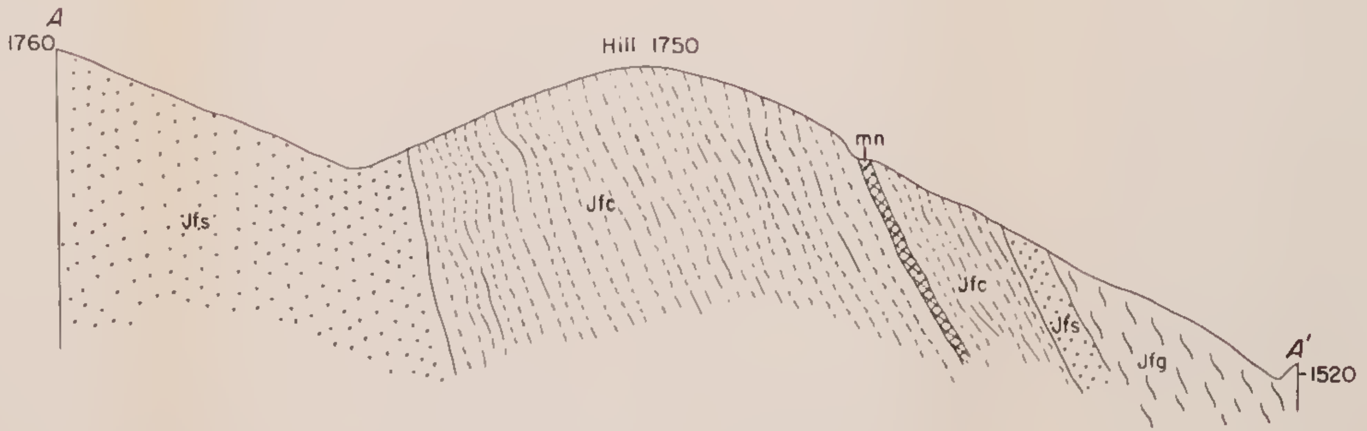
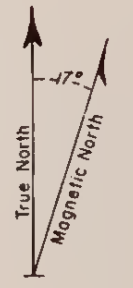
BULLETIN 152
PLATE 3


Ridge 1850
Jfc
Jfs
Jfg
Jfc
1600
1700
1800
65
55
trail
A'
Jfc
Hill 1750
r Jfc
wh
r Jfc
wh Jfc
Jfc
80
65
75
70
45
60
wh Jfc
r Jfc
Jfs
Jfg
1600
Jfc
1700
Jfs
road
A
1800
Jfc
r Jfc
wh Jfc
Hill 1810
EXPLANATION
Landslide
Jfs
Sandstone
(includes siltstone, sandy shale and clay shale)
Jfc
Chert
(wh Jfc - white chert)
(r Jfc - red chert)
Manganese ore
(includes low grade siliceous ore not mined)
Jfg
Greenstone
Franciscan group
JURASSIC (?)
30
Strike and dip of beds
Strike of vertical beds
Adit
Caved adit
Contact
(dashed where approximate)
Fault
Open cut
Mine dump
Shaft
0
50
100
200
300
400
Scale in feet
Contour interval - 20 feet
Datum established by barometer


A
1760
Hill 1750
mn
Jfs
Jfc
Jfc
Jfs
Jfg
A'
1520

GEOLOGIC SECTION ALONG LINE A-A'


True North
Magnetic North
17°

Plane table survey by Ivan F Wilson and Max D Crittenden, Jr., June 17-27, 1942

GEOLOGIC AND TOPOGRAPHIC MAP OF THE THOMAS MINE, MENDOCINO COUNTY, CALIFORNIA

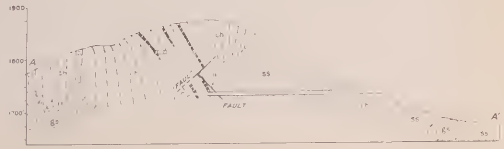
GEOLOGIC MAP AND SECTIONS

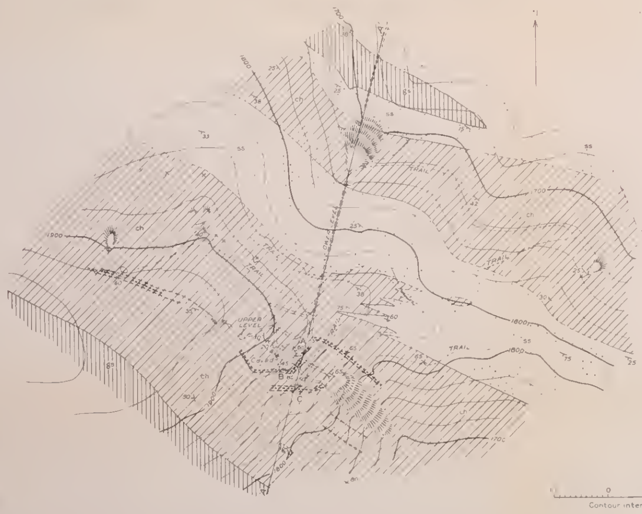
CUMMINGS MINE AREA
SAN JOAQUIN COUNTY, CALIFORNIA

W. G. PIERCE, F. S. SIMONS, H. P. NORBECK AND P. D. TRASK

1941

Reprinted from U S Geological Survey Preliminary Map


1900
1800
1700
A
A'
ch
55
Fault
gs


1900
1800
1700
ch
gs
55
Trail
Upper level
Caved
A
B
C
0
200 Feet
Contour interval 25 feet

EXPLANATION

JURASSIC
Franciscan group

ss
Predominantly sandstone

ch
Predominantly chert

gs
Greenstone

Stratigraphic horizon of manganese bed

Trace of bedding in chert

10
Strike and dip of beds

Strike of vertical beds

85
Strike and dip of overturned beds

Adit

Caved adit

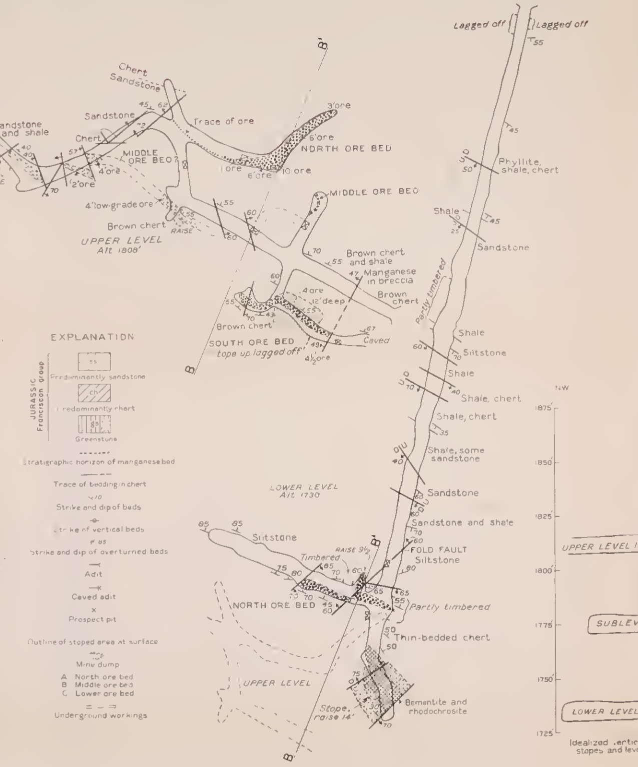
×
Prospect pit

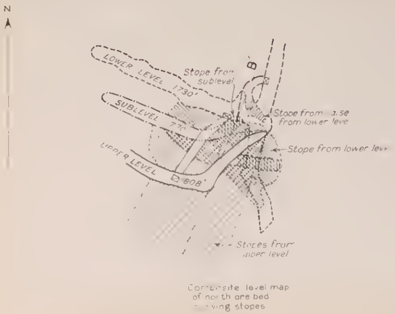
Outline of stoped area at surface

Mine dump

A North ore bed
B Middle ore bed
C Lower ore bed

Underground workings


Lagged off
Lagged off
55
B'
Chert
Sandstone
Sandstone
45
62
Trace of ore
3' ore
6' ore
NORTH ORE BED
10' ore
6' ore
1' ore
45
Sandstone and shale
2' low-grade ore
40
Chert
57
MIDDLE ORE BED?
4' ore
2' ore
RAISE
70
4' low-grade ore
Brown chert
RAISE
UPPER LEVEL
Alt 1808'
55
60
MIDDLE ORE BED
45
Phyllite, shale, chert
50
Shale
25
45
Sandstone
70
Brown chert and shale
55
47
Manganese in breccia
Brown chert
60
4' ore
12' deep
55
Brown chert
SOUTH ORE BED
Stope up lagged off
49
4½' ore
67
Caved
Partly timbered
Shale
Siltstone
60
70
Shale
70
40
Shale, chert
Shale, chert
35
Shale, some sandstone
40
LOWER LEVEL
Alt 1730
Sandstone
Sandstone and shale
85
85
Siltstone
RAISE 9½'
FOLD FAULT
Siltstone
Timbered
75
80
65
60
80
70
65
NORTH ORE BED
45
60
55
Partly timbered
UPPER LEVEL
50
Thin-bedded chert
50
75
Bementite and rhodochrosite
Stope, raise 14'
70
B
B'


N
LOWER LEVEL 1730'
Stope from sublevel
B
SUBLEVEL 1770'
Stope from raise from lower level
Stope from lower level
UPPER LEVEL 1808'
Stopes from upper level

Composite level map of north ore bed showing stopes

EXPLANATION

Manganese oxide

Primary ore (Rhodochrosite and bementite)

Stock work ore

60
Fault showing dip

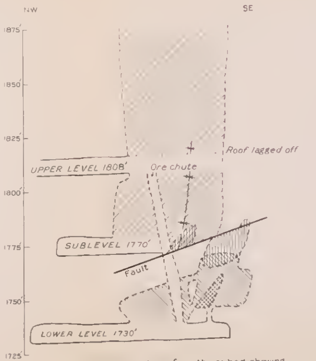
55
Strike and dip of beds

Stope

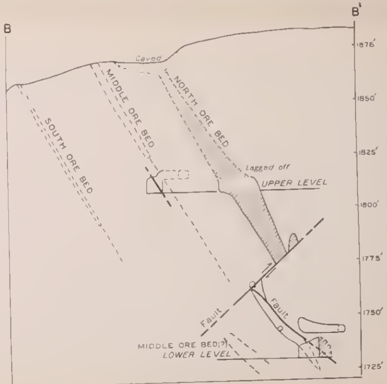
Head of raise

Foot of raise

0
50 Feet


NW
SE
B
1875
1850
1825
1800
1775
1750
1725
UPPER LEVEL 1808'
Roof lagged off
Ore chute
SUBLEVEL 1770'
Fault
LOWER LEVEL 1730'

Idealized vertical projection of north ore bed showing stopes and levels. Strike of projection N 65° W


B
B'
1875'
1850'
1825'
1800'
1775'
1750'
1725'
Caved
SOUTH ORE BED
MIDDLE ORE BED
NORTH ORE BED
Lagged off
UPPER LEVEL
Fault
Fault
MIDDLE ORE BED(?)
LOWER LEVEL

Section along line B-B'

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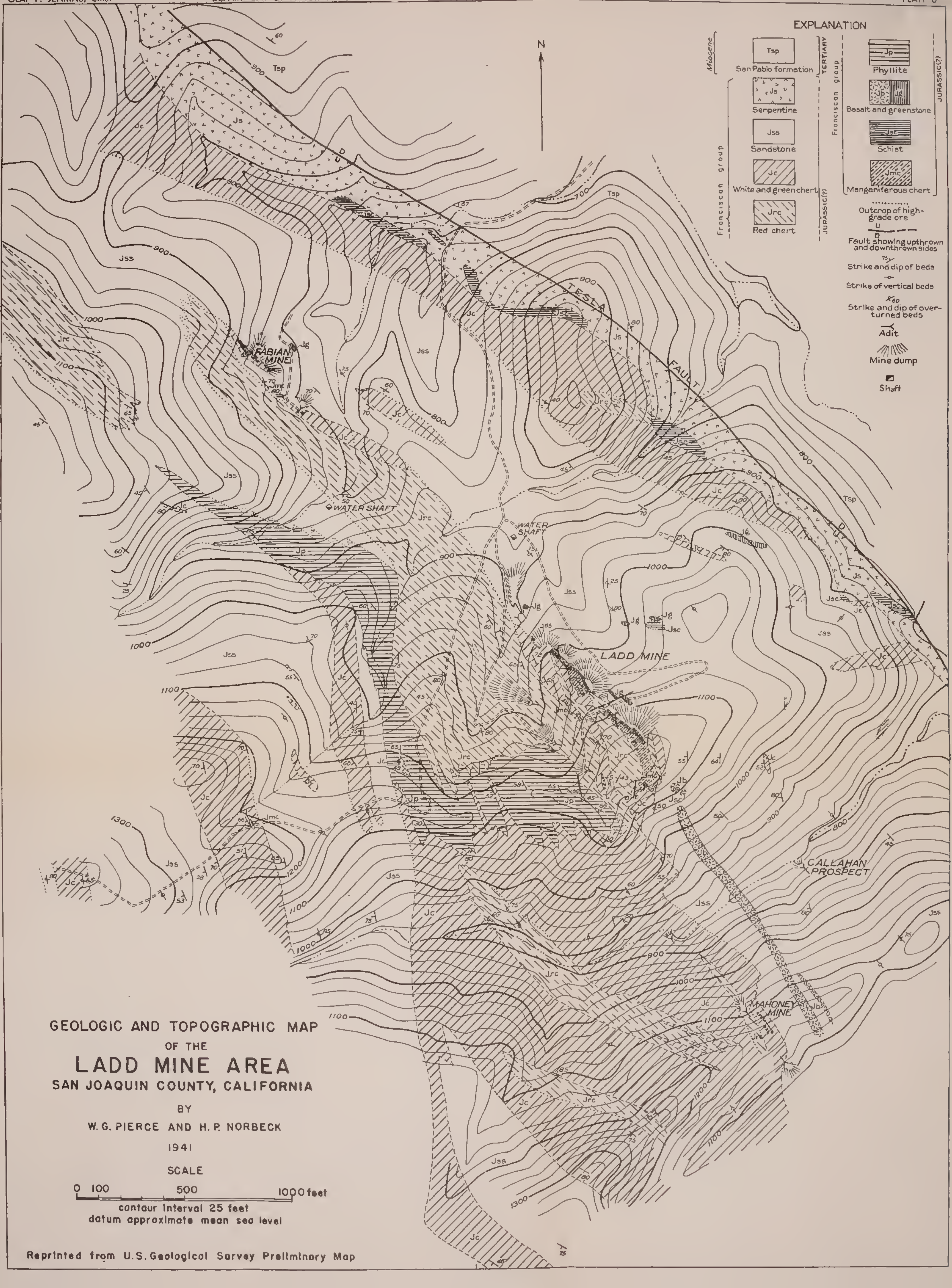

EXPLANATION
Miocene
Tsp
San Pablo formation
TERTIARY
Js
Serpentine
Jss
Sandstone
Jc
White and green chert
Jrc
Red chert
Franciscan group
JURASSIC(?)
Jp
Phyllite
Jb Jg
Basalt and greenstone
Jsc
Schist
Jmc
Manganiferous chert
Outcrop of high-grade ore
U D
Fault showing upthrown and downthrown sides
75
Strike and dip of beds
Strike of vertical beds
60
Strike and dip of overturned beds
Adit
Mine dump
Shaft
N
TESLA FAULT
FABIAN MINE
WATER SHAFT
LADD MINE
CALLAHAN PROSPECT
MAHONEY MINE
Tsp
Js
Jss
Jc
Jrc
Jp
Jsc
Jmc
Jg
Jb
700
800
900
1000
1100
1200
1300

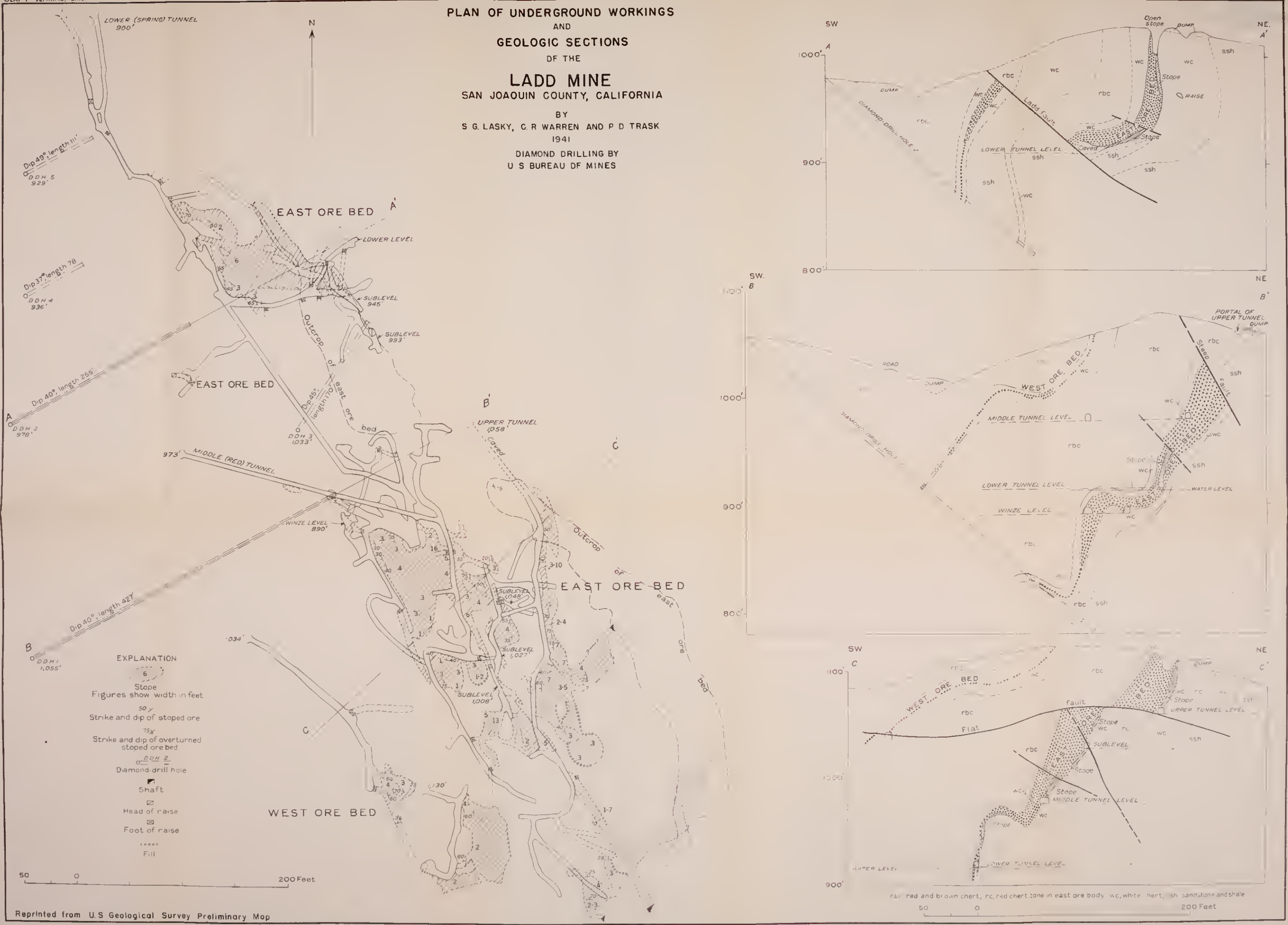
GEOLOGIC AND TOPOGRAPHIC MAP
OF THE
LADD MINE AREA
SAN JOAQUIN COUNTY, CALIFORNIA
BY
W. G. PIERCE AND H. P. NORBECK
1941
SCALE
0 100 500 1000 feet
contour interval 25 feet
datum approximate mean sea level

Reprinted from U. S. Geological Survey Preliminary Map

PLAN OF UNDERGROUND WORKINGS
AND
GEOLOGIC SECTIONS
OF THE
LADD MINE
SAN JOAQUIN COUNTY, CALIFORNIA

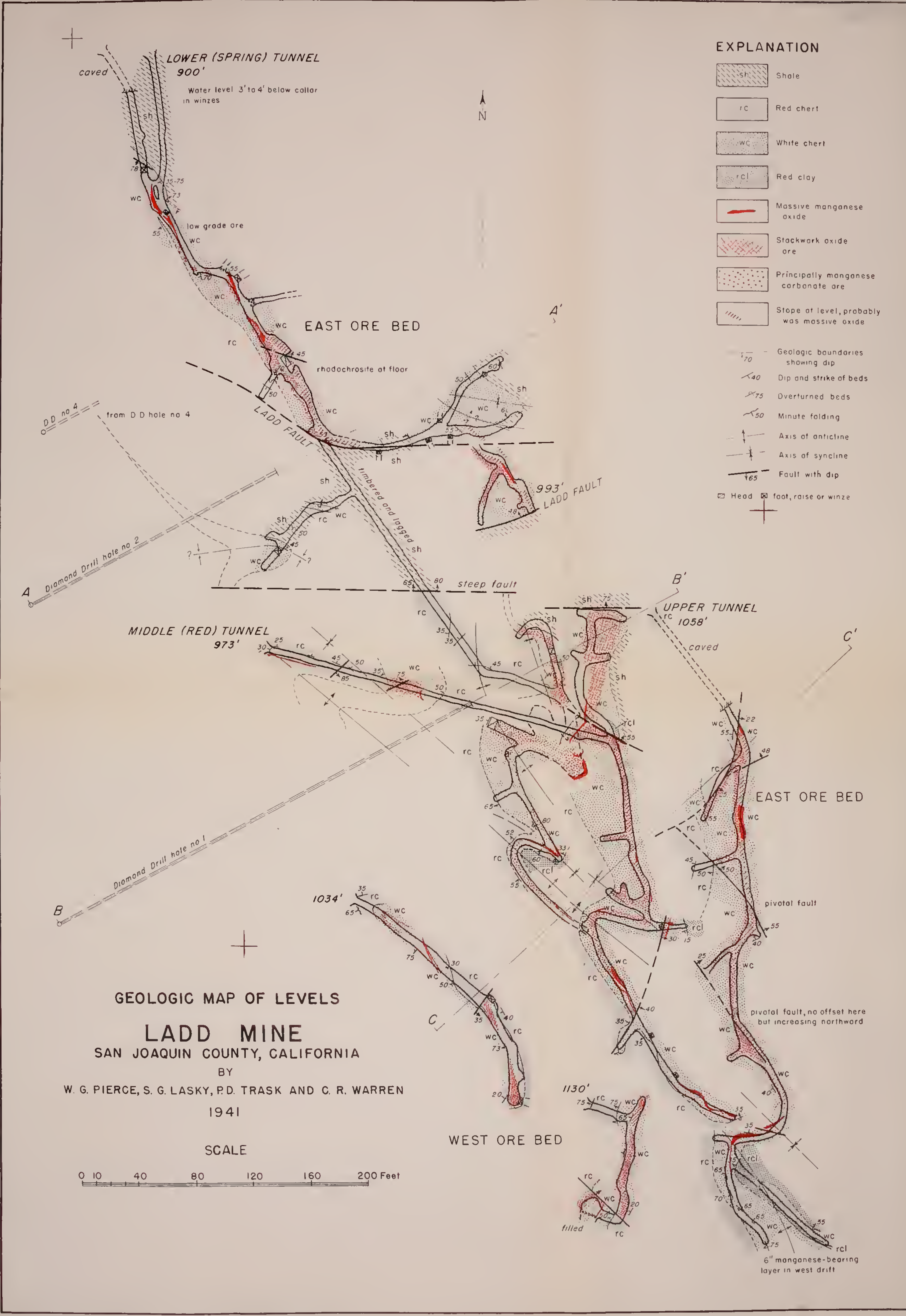
BY
S. G. LASKY, C. R. WARREN AND P. D. TRASK
1941

DIAMOND DRILLING BY
U. S. BUREAU OF MINES


N
LOWER (SPRING) TUNNEL 900'
Dip 49°, length 111'
DDH 5 929'
Dip 37°, length 78
DDH 4 936'
Dip 40°, length 255'
A
DDH 2 978'
Dip 40°, length 427
B
DDH 1 1,055'
EAST ORE BED
A'
LOWER LEVEL
SUBLEVEL 945'
SUBLEVEL 993'
Outcrop of east ore bed
EAST ORE BED
Dip 45°, length 170
DDH 3 1,033'
B'
UPPER TUNNEL 1,058'
Caved
C'
973'
MIDDLE (RED) TUNNEL
WINZE LEVEL 890'
Outcrop of east ore bed
EAST ORE BED
SUBLEVEL 1,048'
SUBLEVEL 1,027'
SUBLEVEL 1,008'
1,034'
C
WEST ORE BED
1,130'
EXPLANATION
6
Stope
Figures show width in feet
50
Strike and dip of stoped ore
75
Strike and dip of overturned stoped ore bed
DDH 2
Diamond-drill hole
Shaft
Head of raise
Foot of raise
Fill
50 0 200 Feet
SW
NE
A
A'
1000'
900'
800'
Open Stope
DUMP
DUMP
DIAMOND DRILL HOLE 2
rbc
wc
ssh
Ladd fault
EAST ORE BED
Stope
RAISE
Caved
LOWER TUNNEL LEVEL
SW.
NE
B
B'
1100'
1000'
900'
800'
PORTAL OF UPPER TUNNEL
DUMP
ROAD
DUMP
DIAMOND DRILL HOLE 1
WEST ORE BED
Steep fault
MIDDLE TUNNEL LEVEL
Stope
EAST ORE BED
LOWER TUNNEL LEVEL
WATER LEVEL
WINZE LEVEL
rbc
wc
ssh
SW
NE
C
C'
1100'
1000'
900'
WEST ORE BED
DUMP
fault
Flat
EAST ORE BED
Stope
UPPER TUNNEL LEVEL
SUBLEVEL
Stope
MIDDLE TUNNEL LEVEL
Stope
WATER LEVEL
LOWER TUNNEL LEVEL
rbc
rc
wc
ssh
rbc, red and brown chert; rc, red chert zone in east ore body; wc, white chert; ssh, sandstone and shale
50 0 200 Feet

Reprinted from U. S. Geological Survey Preliminary Map

GEOLOGY


LOWER (SPRING) TUNNEL 900'
caved
Water level 3' to 4' below collar in winzes
N
low grade ore
EAST ORE BED
rhodochrosite at floor
LADD FAULT
D D no 4
from D D hole no 4
timbered and lagged
993' LADD FAULT
A'
A
Diamond Drill hole no 2
steep fault
B'
UPPER TUNNEL 1058'
caved
C'
MIDDLE (RED) TUNNEL 973'
EAST ORE BED
pivotal fault
Diamond Drill hole no 1
B
1034'
pivotal fault, no offset here but increasing northward
C
1130'
WEST ORE BED
filled
6" manganese-bearing layer in west drift
sh
rc
wc
rcl
EXPLANATION
Shale
Red chert
White chert
Red clay
Massive manganese oxide
Stockwork oxide ore
Principally manganese carbonate ore
Stope at level, probably was massive oxide
Geologic boundaries showing dip
Dip and strike of beds
Overturned beds
Minute folding
Axis of anticline
Axis of syncline
Fault with dip
Head foot, raise or winze

GEOLOGIC MAP OF LEVELS

LADD MINE

SAN JOAQUIN COUNTY, CALIFORNIA

BY
W. G. PIERCE, S. G. LASKY, P.D. TRASK AND C. R. WARREN
1941

SCALE

0 10 40 80 120 160 200 Feet

DIVISION OF MINES
OLAF P. JENKINS, *Chief*

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

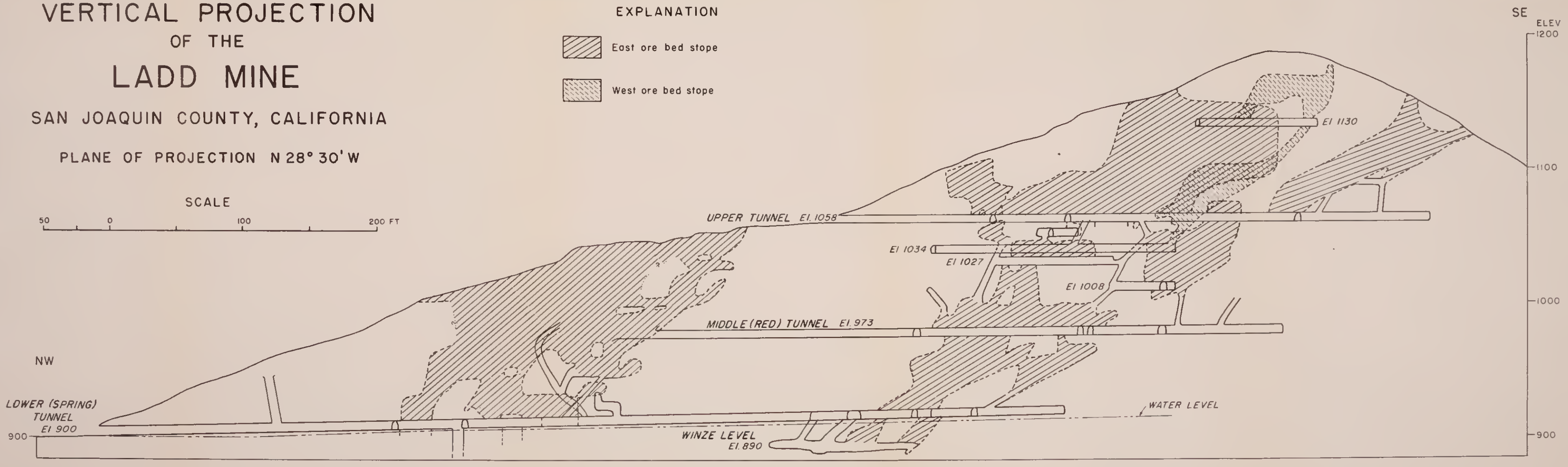
BULLETIN 152
PLATE 9

VERTICAL PROJECTION
OF THE
LADD MINE
SAN JOAQUIN COUNTY, CALIFORNIA
PLANE OF PROJECTION N 28° 30' W

EXPLANATION

▨ East ore bed stope

▨ West ore bed stope


SCALE
50
0
100
200 FT
SE
ELEV
1200
1100
1000
900
El 1130
UPPER TUNNEL El. 1058
El 1034
El 1027
El 1008
MIDDLE (RED) TUNNEL El. 973
NW
LOWER (SPRING) TUNNEL El 900
900
WATER LEVEL
WINZE LEVEL El. 890

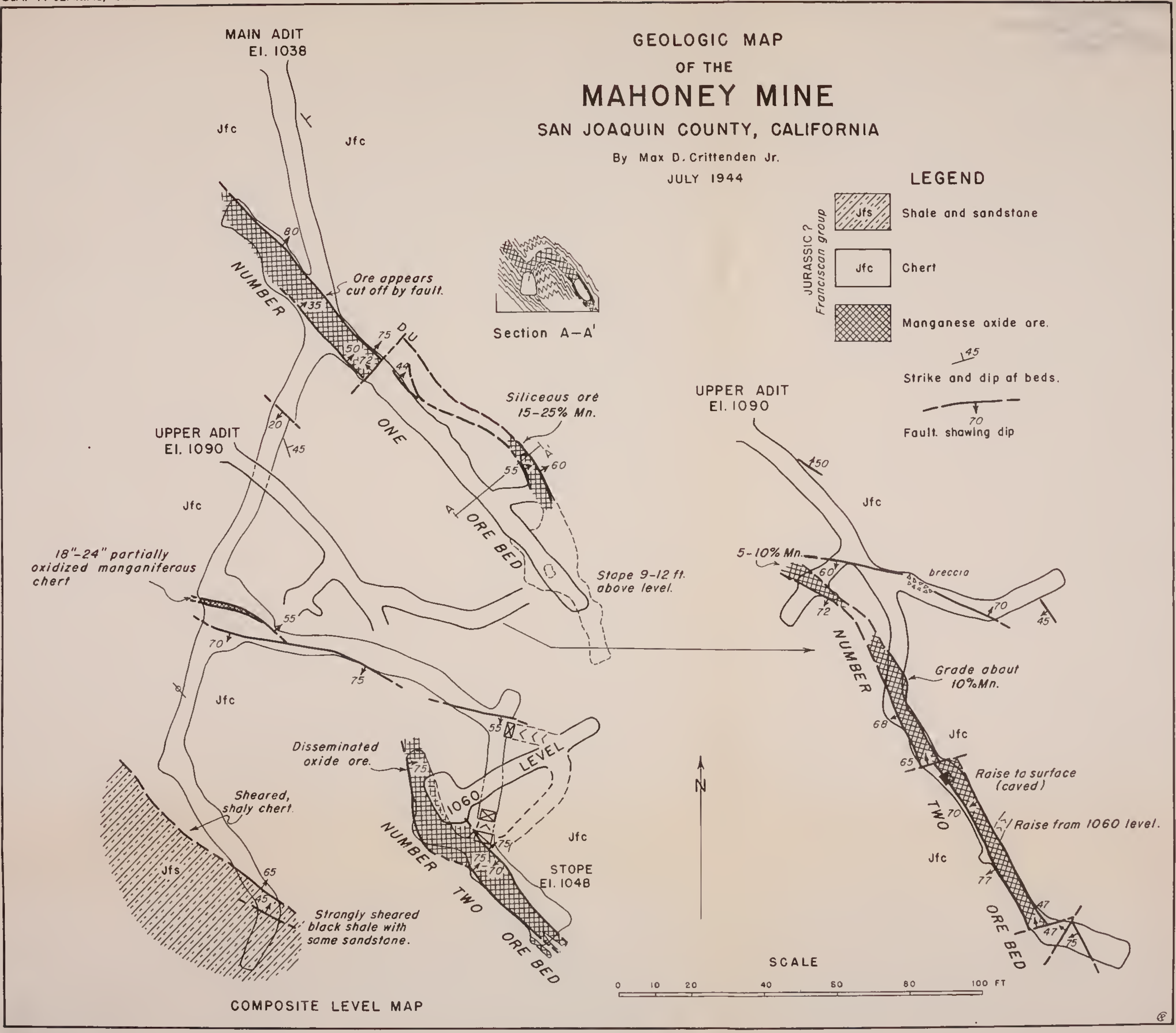
BY C. R WARREN, 1941

GEOLOGIC MAP OF THE MAHONEY MINE

SAN JOAQUIN COUNTY, CALIFORNIA

By Max D. Crittenden Jr.

JULY 1944


MAIN ADIT
El. 1038
Jfc
Jfc
80
NUMBER
ONE
ORE BED
Ore appears cut off by fault.
35
75
D
U
50
72
44
Siliceous ore 15–25% Mn.
A
A'
55
60
Section A–A'
UPPER ADIT
El. 1090
20
45
Jfc
Stope 9–12 ft. above level.
18"–24" partially oxidized manganiferous chert
55
70
75
Jfc
55
Disseminated oxide ore.
75
1060
LEVEL
75
75
70
Sheared, shaly chert.
Jfs
65
45
Strongly sheared black shale with some sandstone.
NUMBER
TWO
ORE BED
Jfc
STOPE
El. 1048
COMPOSITE LEVEL MAP
N
LEGEND
JURASSIC? Franciscan group
Jfs
Shale and sandstone
Jfc
Chert
Manganese oxide ore.
45
Strike and dip of beds.
70
Fault, showing dip
UPPER ADIT
El. 1090
50
Jfc
5–10% Mn.
60
72
breccia
70
45
NUMBER
Grade about 10% Mn.
68
Jfc
65
Raise to surface (caved)
TWO
70
Raise from 1060 level.
Jfc
77
ORE BED
47
47
75
SCALE
0
10
20
40
60
80
100 FT

DIVISION OF MINES
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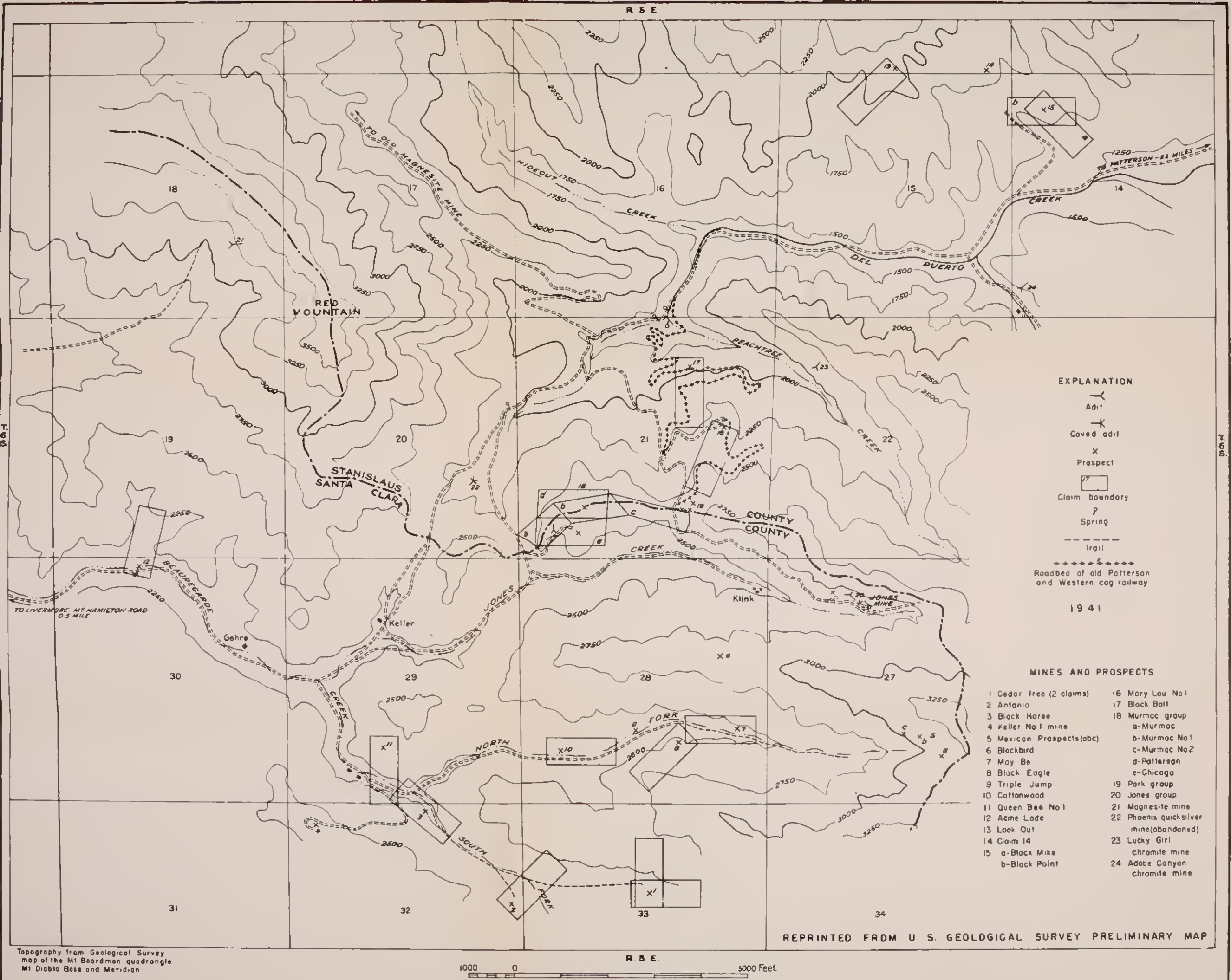
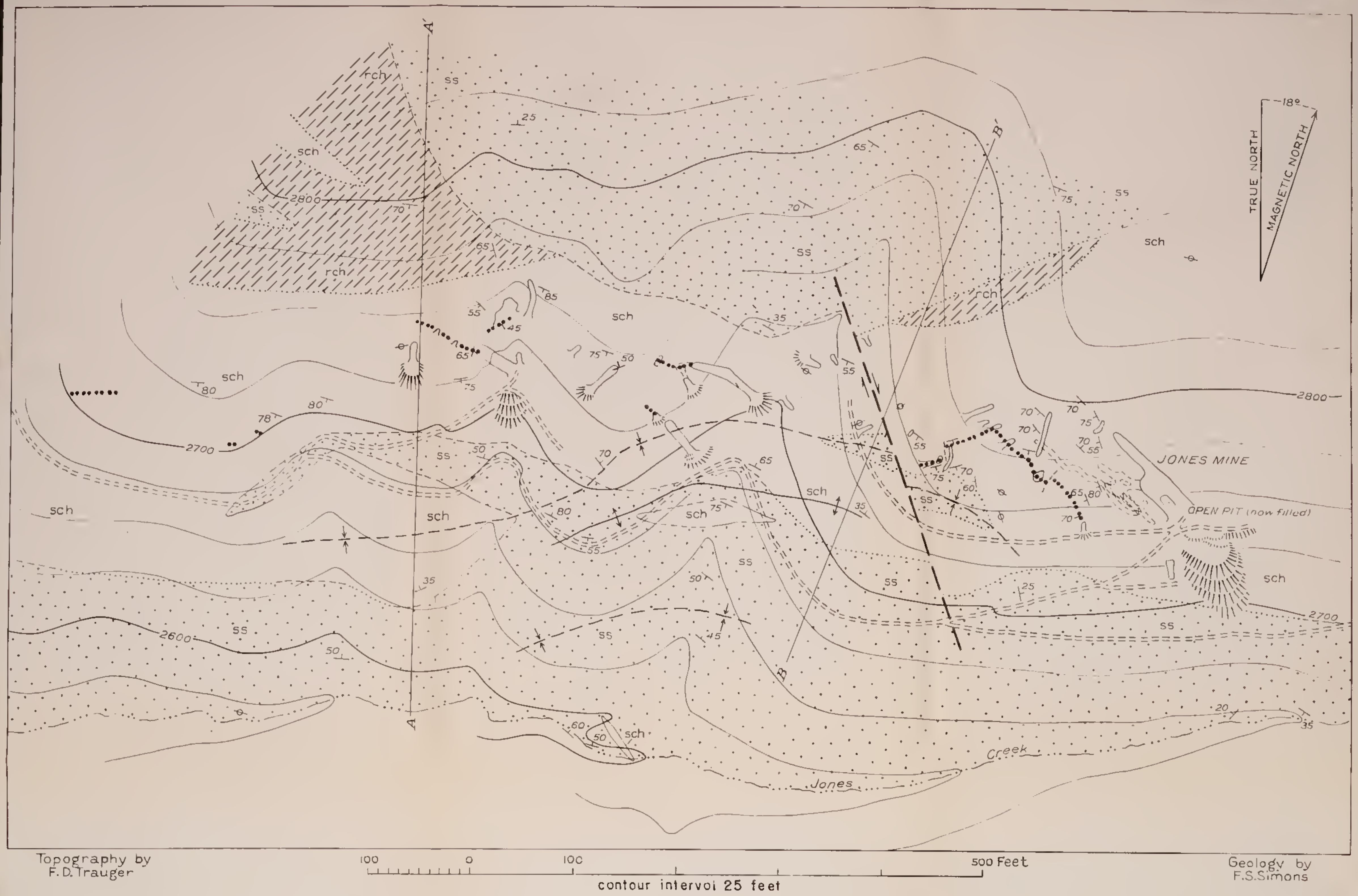
STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BULLETIN 152
PLATE 11


R. 5 E.
T. 6 S.
TO OLD MAGNESITE MINE
HIDEOUT CREEK
DEL PUERTO CREEK
TO PATTERSON—22 MILES
PEACHTREE CREEK
RED MOUNTAIN
STANISLAUS COUNTY
SANTA CLARA COUNTY
JONES CREEK
BEAUREGARDE CREEK
NORTH FORK
SOUTH FORK
TO LIVERMORE-MT HAMILTON ROAD 0.5 MILE
Keller
Gehre
Klink
JONES MINE
1750
2000
2250
2500
2750
3000
3250
3500
1500
1250
EXPLANATION
Adit
Caved adit
Prospect
Claim boundary
Spring
Trail
Roadbed of old Patterson and Western cog railway
1941
MINES AND PROSPECTS
1 Cedar Tree (2 claims)
2 Antonio
3 Black Horse
4 Keller No 1 mine
5 Mexican Prospects (abc)
6 Blackbird
7 May Be
8 Black Eagle
9 Triple Jump
10 Cottonwood
11 Queen Bee No 1
12 Acme Lode
13 Look Out
14 Claim 14
15 a-Black Mike
b-Black Point
16 Mary Lou No 1
17 Black Bolt
18 Murmac group
a-Murmac
b-Murmac No 1
c-Murmac No 2
d-Patterson
e-Chicago
19 Park group
20 Jones group
21 Magnesite mine
22 Phoenix quicksilver mine (abandoned)
23 Lucky Girl chromite mine
24 Adobe Canyon chromite mine
REPRINTED FROM U. S. GEOLOGICAL SURVEY PRELIMINARY MAP
Topography from Geological Survey map of the Mt Boardman quadrangle Mt Diablo Base and Meridian
1000 0 5000 Feet
Contour interval 250 feet

TOPOGRAPHIC MAP OF THE BLACK WONDER AREA, SANTA CLARA AND STANISLAUS COUNTIES, CALIFORNIA
SHOWING LOCATION OF MANGANESE DEPOSITS


A
A'
B
B'
TRUE NORTH
MAGNETIC NORTH
18°
sch
ss
rch
2800
2700
2600
JONES MINE
OPEN PIT (now filled)
Jones
Creek
Topography by F. D. Trauger
Geology by F. S. Simons
100
0
100
500 Feet
contour intervol 25 feet

EXPLANATION

sch rch
Interbedded shale and chert, sch; with red, thin-bedded chert, rch

ss
Sandstone

Manganese oxide ore

Fault, showing direction of movement

70
Strike and dip of beds

Strike of vertical beds

Axis of anticline

Axis of syncline

Head of winze

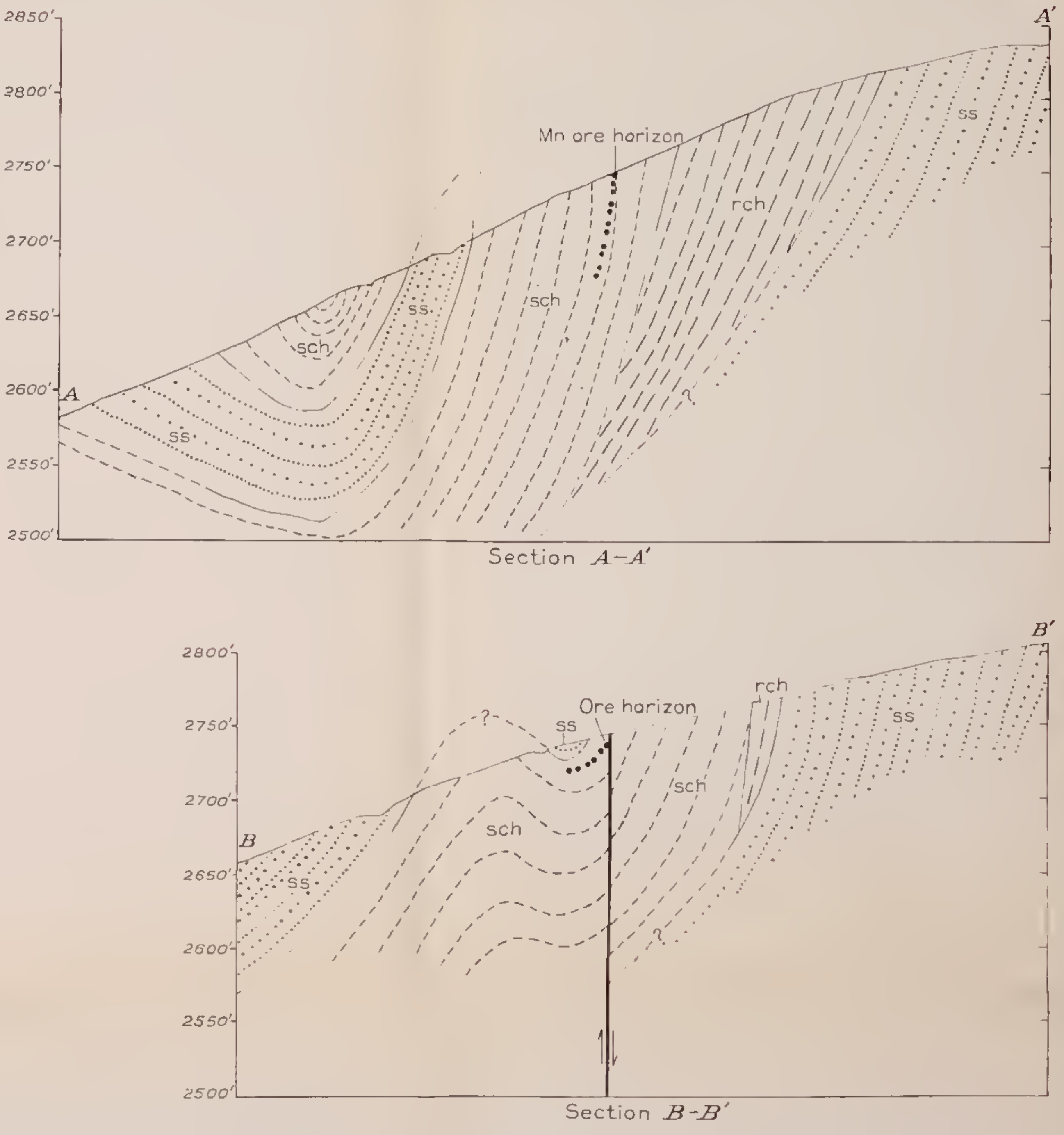
Foot of winze

Underground workings

Trench

Open cut

Dump


2850'
2800'
2750'
2700'
2650'
2600'
2550'
2500'
A
A'
Mn ore horizon
ss
sch
rch
Section A–A'
B
B'
Ore horizon
Section B–B'

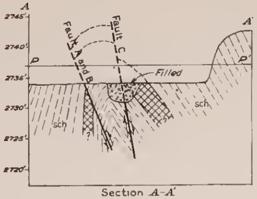
GEOLOGIC MAP AND SECTIONS

JONES MINE, BLACK WONDER AREA

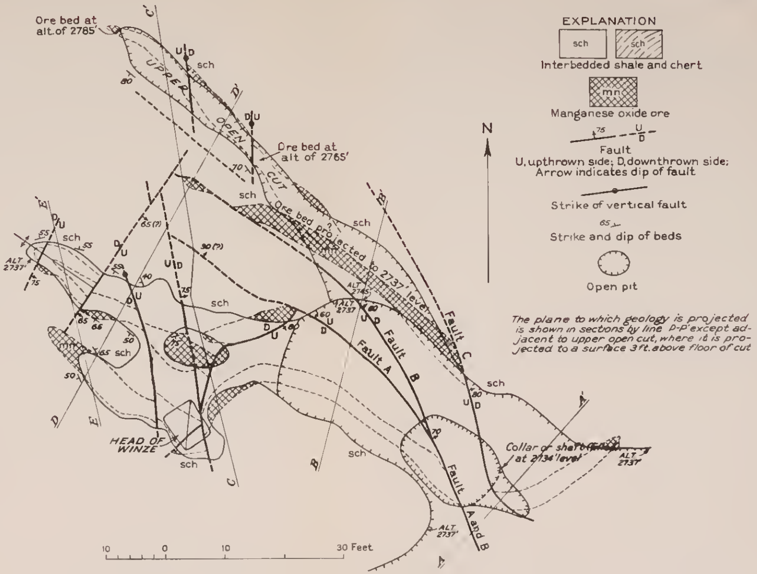
SANTA CLARA COUNTY, CALIFORNIA

1941

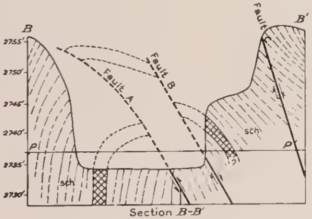
REPRINTED FROM U. S. GEOLOGICAL SURVEY PRELIMINARY MAP


A
A'
2745'
2740'
2736'
2730'
2725'
2720'
P
P'
Fault A and B
Fault C
Filled
sch
sch
?

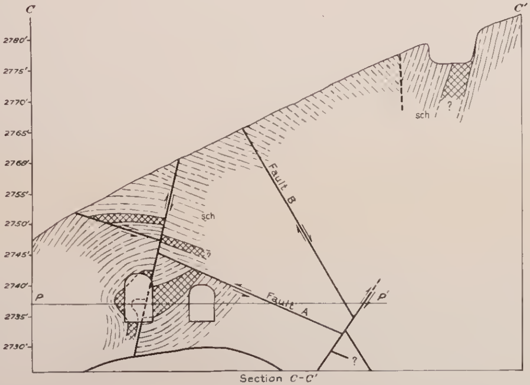
Section A-A'


EXPLANATION
sch
sch
Interbedded shale and chert
mn
Manganese oxide ore
75
U
D
Fault
U, upthrown side; D, downthrown side; Arrow indicates dip of fault
Strike of vertical fault
65
Strike and dip of beds
Open pit
The plane to which geology is projected is shown in sections by line P-P' except adjacent to upper open cut, where it is projected to a surface 3 ft. above floor of cut
N
Ore bed at alt. of 2785'
Ore bed at alt of 2765'
UPPER OPEN CUT
Ore bed projected to 2737' level
Fault A
Fault B
Fault C
Fault A and B
ALT 2737'
ALT 2745'
HEAD OF WINZE
Collar of shaft at 2734' level
sch
mn
U
D
C
C'
D
D'
E
E'
B
B'
A
A'
10
0
10
30 Feet

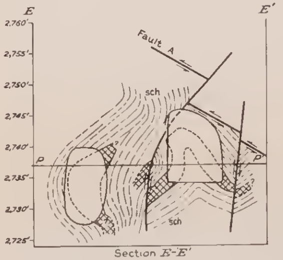
PLAN OF UPPER LEVEL (MAIN ADIT) AND OPEN CUT, WITH GEOLOGY PROJECTED TO ALTITUDE OF 2737 FEET


B
B'
2755'
2750'
2745'
2740'
2735'
2730'
P
P'
Fault A
Fault B
Fault C
sch
sch
?

Section B-B'


C
C'
2780'
2775'
2770'
2765'
2760'
2755'
2750'
2745'
2740'
2735'
2730'
P
P'
Fault B
Fault A
sch
sch
?
?

Section C-C'


E
E'
2,760'
2,755'
2,750'
2,745'
2,740'
2,735'
2,730'
2,725'
P
P'
Fault A
sch
sch
?

Section E-E'

SEE NEXT PLATE FOR SECTION D-D'

PLAN AND SECTIONS

JONES MINE, BLACK WONDER AREA

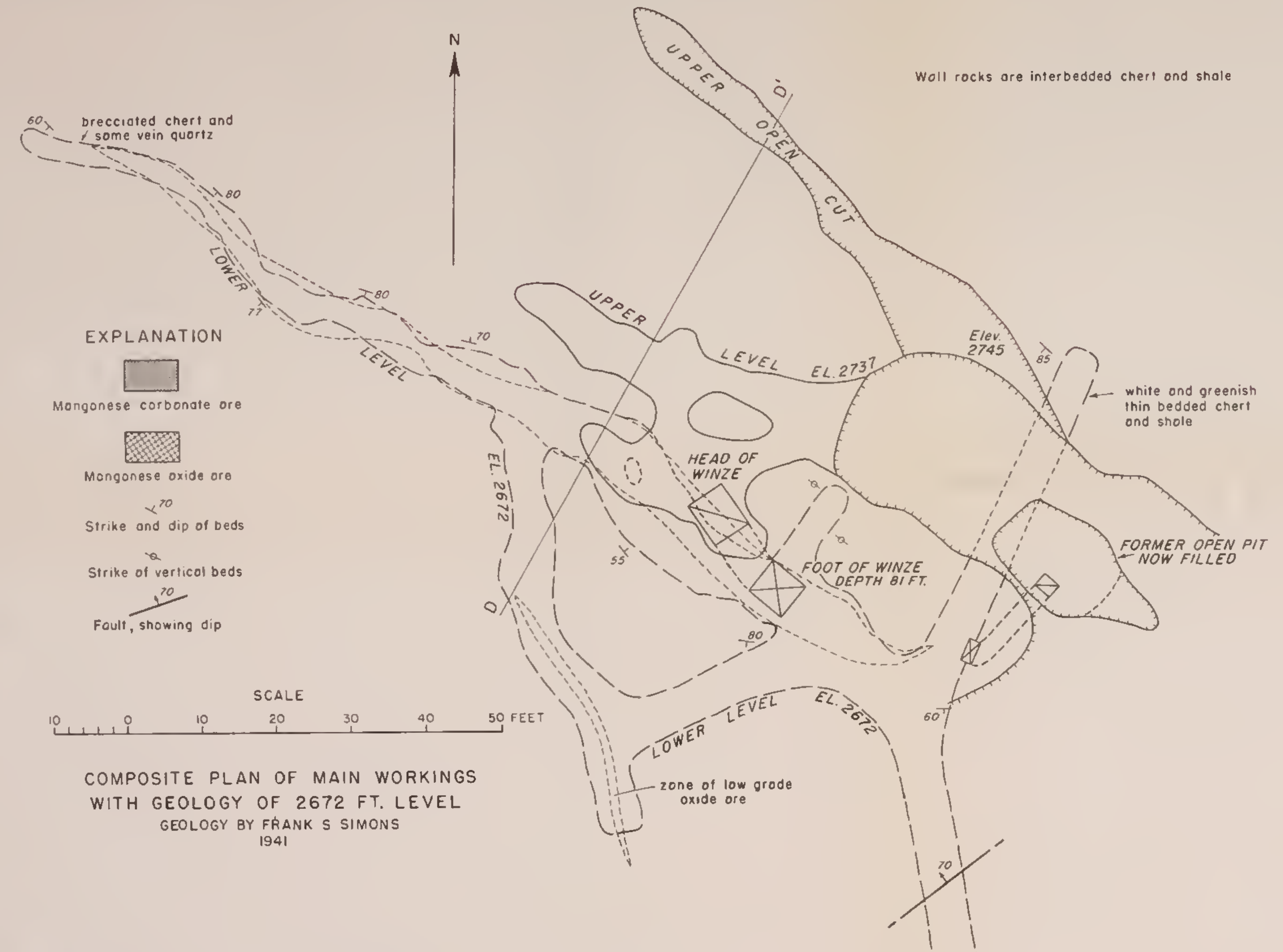
SANTA CLARA COUNTY, CALIFORNIA

(PART I)

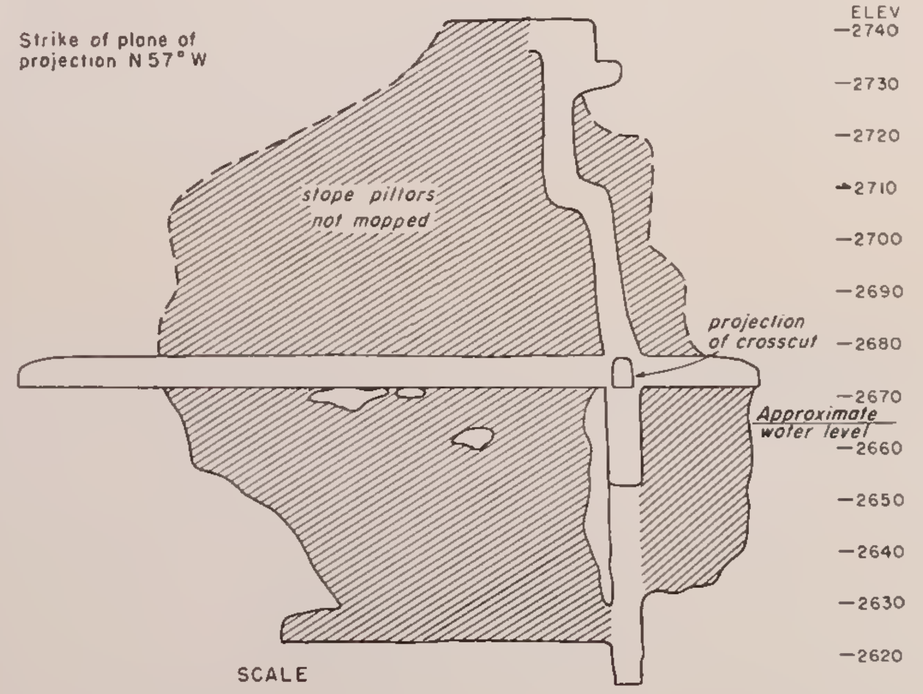
MAPPED BY FRANK S. SIMONS

REPRINTED FROM U S GEOLOGICAL SURVEY PRELIMINARY MAP

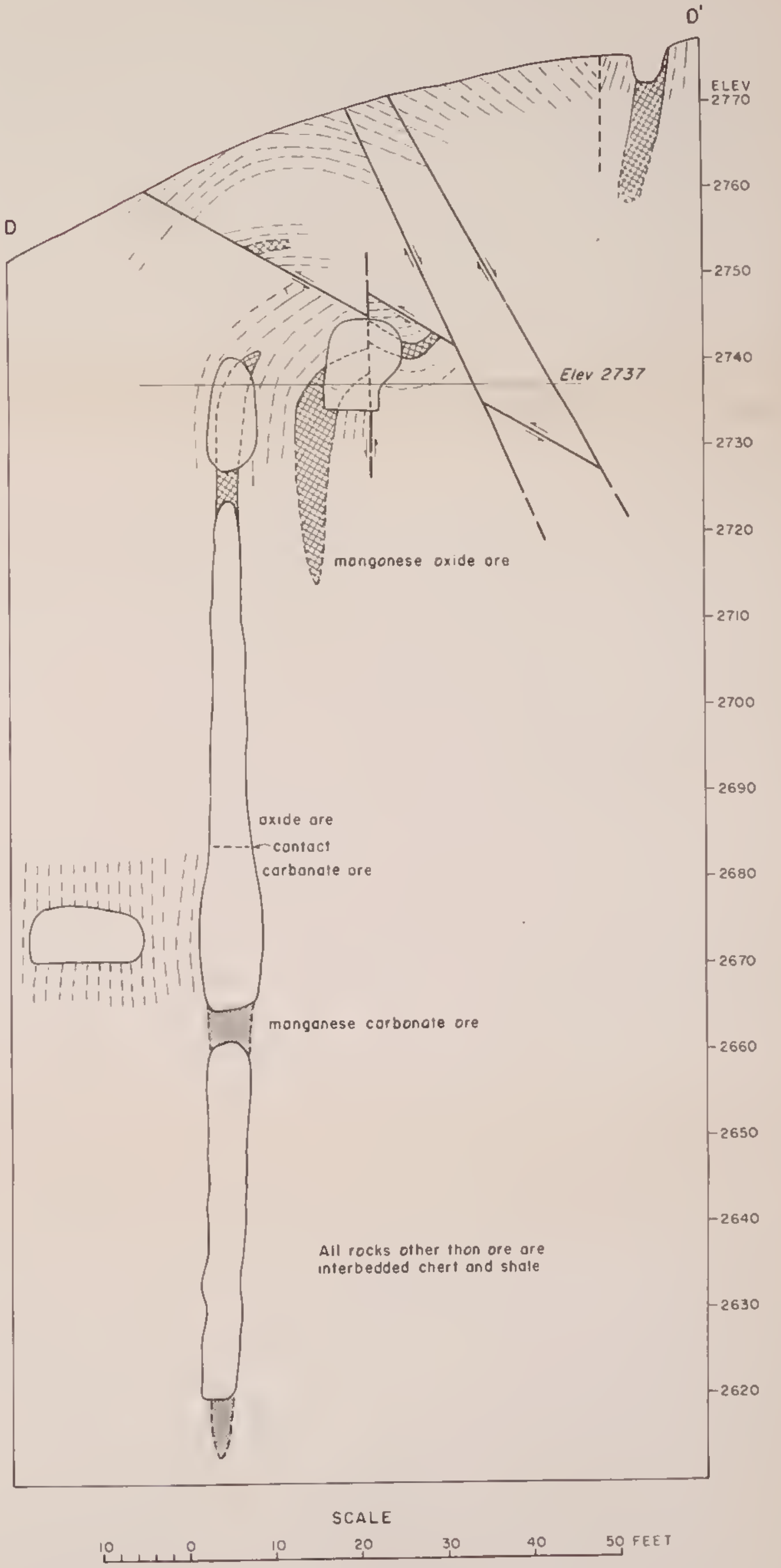
1941


N
Wall rocks are interbedded chert and shale
breccıated chert and some vein quartz
60
80
77
70
UPPER OPEN CUT
D'
UPPER LEVEL EL. 2737
LOWER LEVEL
EL. 2672
Elev. 2745
85
white and greenish thin bedded chert and shale
HEAD OF WINZE
FOOT OF WINZE DEPTH 81 FT.
FORMER OPEN PIT NOW FILLED
55
80
D
LOWER LEVEL EL. 2672
60
zone of low grade oxide ore
EXPLANATION
▨ Manganese carbonate ore
▨ Manganese oxide ore
70 Strike and dip of beds
Strike of vertical beds
70 Fault, showing dip
SCALE
10 0 10 20 30 40 50 FEET
PORTAL OF ADIT Elev. 2675

COMPOSITE PLAN OF MAIN WORKINGS WITH GEOLOGY OF 2672 FT. LEVEL
GEOLOGY BY FRANK S SIMONS
1941


Strike of plane of projection N 57° W
ELEV
2740
2730
2720
2710
2700
2690
2680
2670
2660
2650
2640
2630
2620
stope pillars not mapped
projection of crosscut
Approximate water level
SCALE
10 0 10 20 30 40 50 FEET

VERTICAL PROJECTION OF WEST ORE BED
GEOLOGY BY MAX D CRITTENDEN
1944


D
D'
ELEV
2770
2760
2750
2740
2730
2720
2710
2700
2690
2680
2670
2660
2650
2640
2630
2620
Elev 2737
manganese oxide ore
oxide ore
contact
carbonate ore
manganese carbonate ore
All rocks other than ore are interbedded chert and shale
SCALE
10 0 10 20 30 40 50 FEET

SECTION D-D'

REPRINTED FROM U.S. GEOLOGICAL SURVEY PRELIMINARY MAP

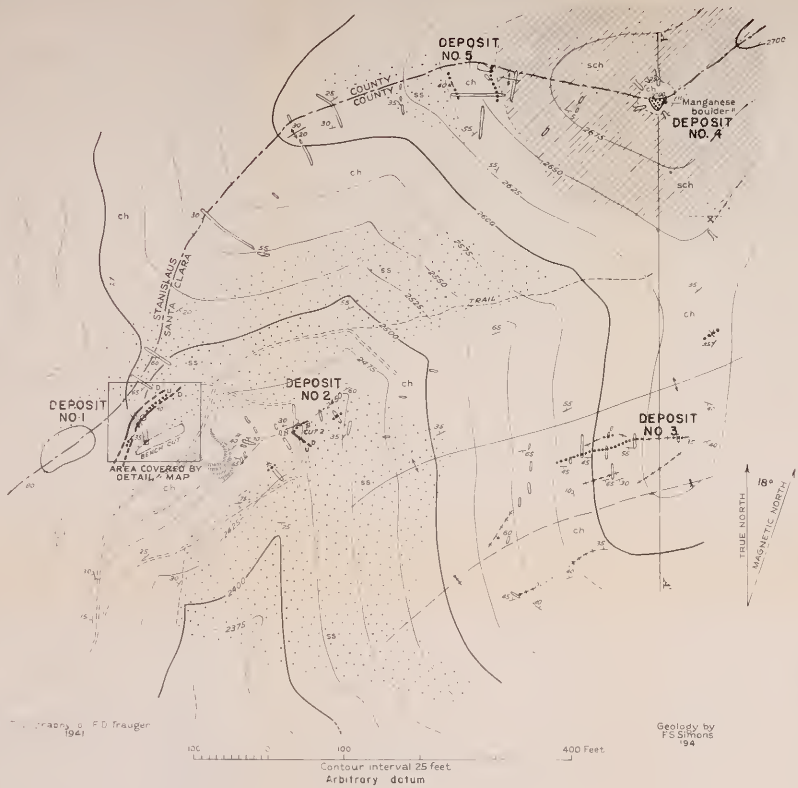
PLAN AND SECTIONS OF THE MINE WORKINGS OF THE JONES MINE BLACK WONDER AREA, SANTA CLARA COUNTY, CALIFORNIA, PART 2

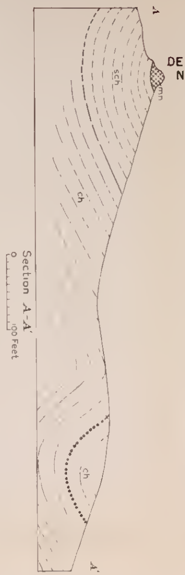
DIVISION OF MINES
OLAF P. JENKINS, *Chief*

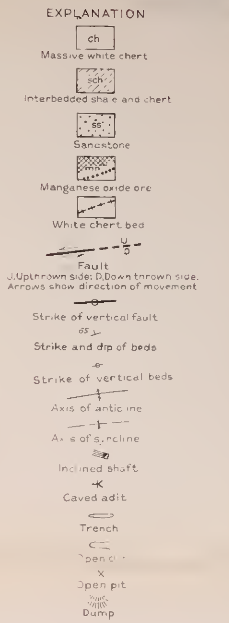
STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

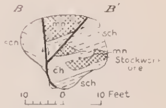
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BULLETIN 152
PLATE 15

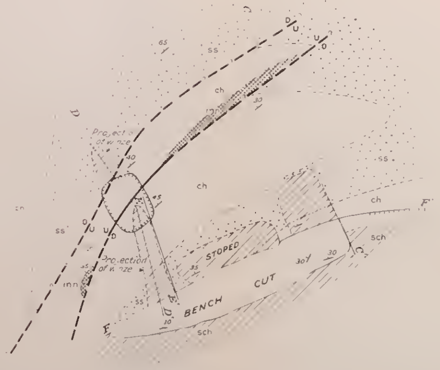

DEPOSIT NO. 5
COUNTY
COUNTY
sch
Manganese boulder
DEPOSIT NO. 4
ch
sch
STANISLAUS
SANTA CLARA
ss
TRAIL
DEPOSIT NO. 2
CUT 2
DEPOSIT NO. 1
BENCH CUT
AREA COVERED BY DETAIL MAP
DEPOSIT NO. 3
TRUE NORTH
MAGNETIC NORTH
18°
2700
2675
2650
2625
2600
2575
2550
2525
2500
2475
2425
2400
2375
Topography by F. D. Trauger 1941
Geology by F. S. Simons 1941
100 0 100 400 Feet
Contour interval 25 feet
Arbitrary datum


A
A'
DEPOSIT NO. 4
sch
mn
ch
Section A-A'
0 100 Feet

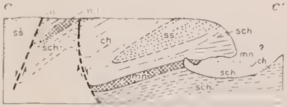

EXPLANATION
ch
Massive white chert
sch
Interbedded shale and chert
ss
Sandstone
mn
Manganese oxide ore
White chert bed
U
D
Fault
U, Upthrown side; D, Downthrown side. Arrows show direction of movement
Strike of vertical fault
65
Strike and dip of beds
Strike of vertical beds
Axis of anticline
Axis of syncline
Inclined shaft
Caved adit
Trench
Open cut
Open pit
Dump


B
B'
sch
mn
Stockwork ore
ch
10 0 10 Feet

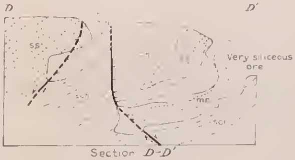
Section *B-B'*
in face of cut 2
DEPOSIT NO. 2


D
U
ss
ch
65
30
Projection of winze
mn
STOPED
BENCH CUT
sch
C
C'
D
D'
E
E'
F
F'

Detail of bench cut

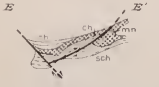

C
C'
ss
sch
ch
mn

Section *C-C'*

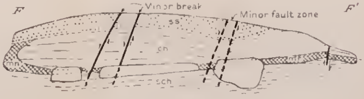

D
D'
ss
ch
Very siliceous ore
mn
sch

Section *D-D'*

DEPOSIT NO. 1



Vertical section *E-E'* along northeast wall of lower winze


F
F'
Minor break
Minor fault zone
ss
ch
mn
sch

Vertical section *F-F'* along face of bench cut

25 0 75 Feet

REPRINTED FROM U.S. GEOLOGICAL SURVEY PRELIMINARY MAP

GEOLOGIC MAP AND SECTIONS OF THE MURMAC DEPOSITS, BLACK WONDER AREA, SANTA CLARA COUNTY, CALIFORNIA

DIVISION OF MINES
OLAF P. JENKINS, *Chief*

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BULLETIN 152
PLATE 16

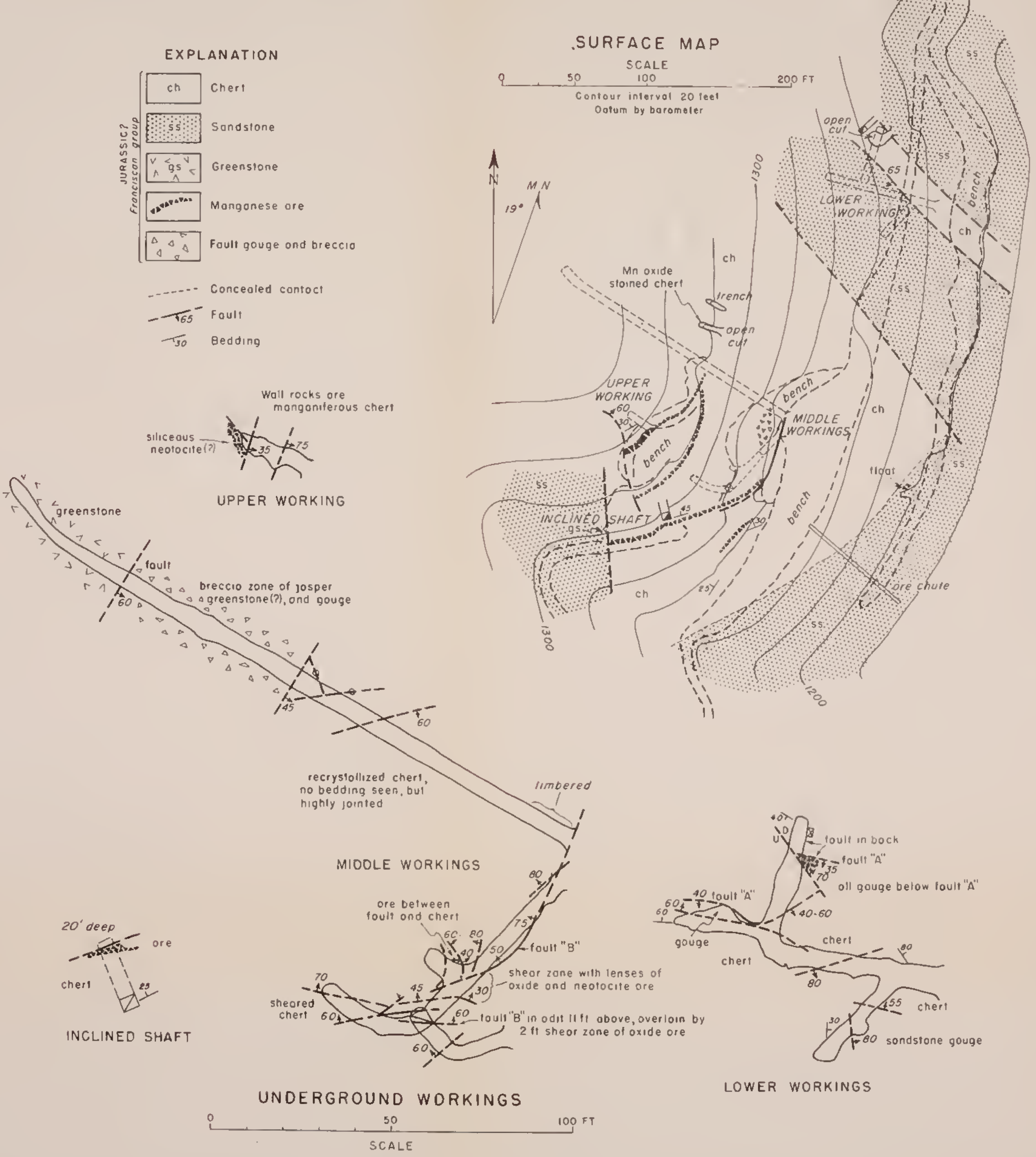
GEOLOGIC AND TOPOGRAPHIC MAP AND UNDERGROUND WORKINGS OF THE

AHO MINE

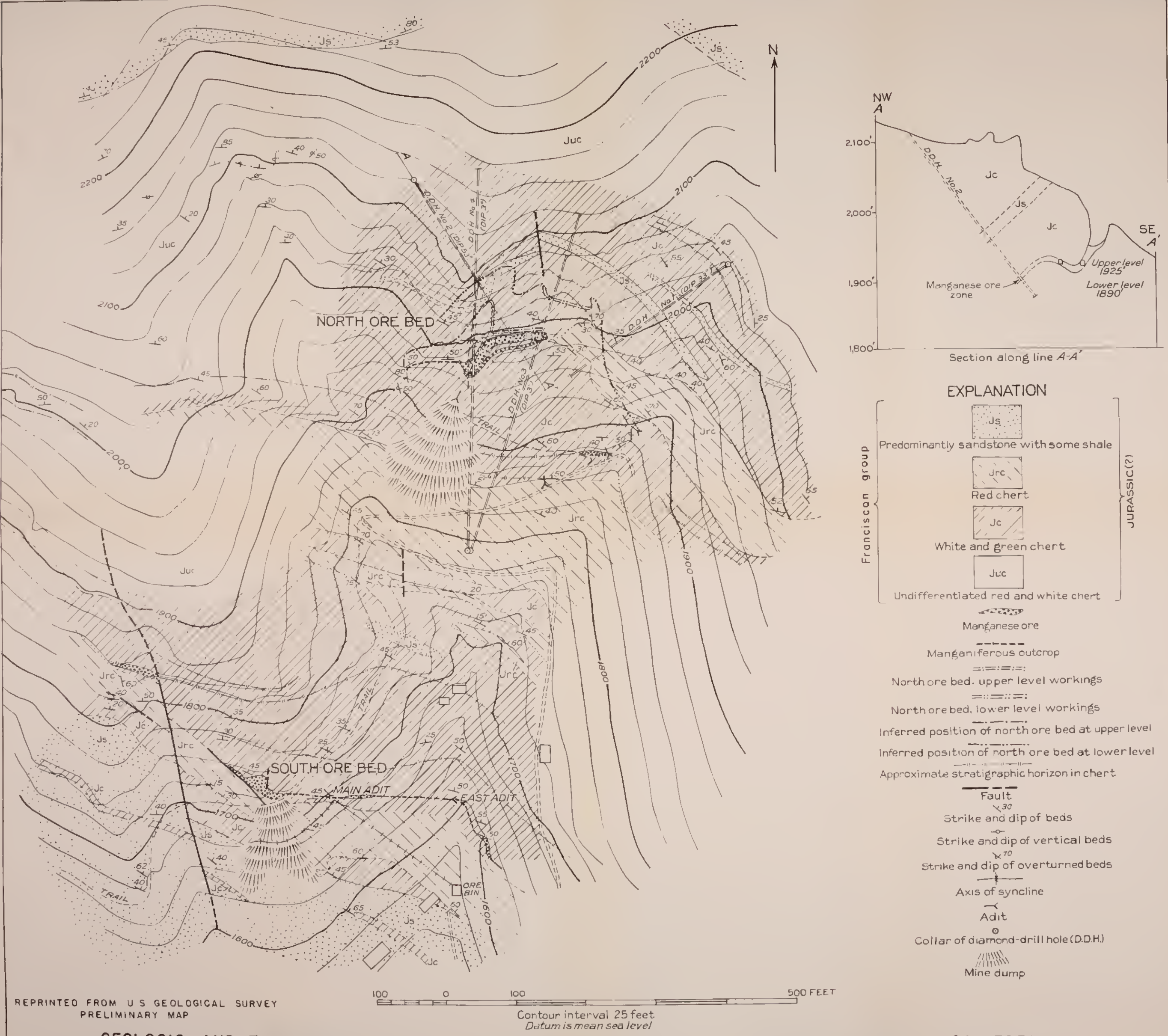
SONOMA COUNTY, CALIFORNIA

Sections 15-16, T8N., R12W. M.D.M.

Plane table survey and geology by
Frank S Simons and Max D Crittenden, Jr
October 1942



EXPLANATION
JURASSIC?
Franciscan group
ch Chert
ss Sandstone
gs Greenstone
Manganese ore
Fault gouge and breccia
Concealed contact
65 Fault
30 Bedding
SURFACE MAP
SCALE
0 50 100 200 FT
Contour interval 20 feet
Datum by barometer
N
MN
19°
1300
1200
open cut
65
LOWER WORKINGS
bench
ch
ss
Mn oxide stained chert
trench
open cut
UPPER WORKING
60
30
MIDDLE WORKINGS
float
INCLINED SHAFT
gs
45
30
25
ore chute
Wall rocks are manganiferous chert
siliceous neotocite(?)
35
75
UPPER WORKING
greenstone
fault
60
breccia zone of jasper, greenstone(?), and gouge
45
60
recrystallized chert, no bedding seen, but highly jointed
timbered
MIDDLE WORKINGS
80
ore between fault and chert
6C
80
40
50
75
fault "B"
shear zone with lenses of oxide and neotocite ore
30
45
70
sheared chert
60
60
fault "B" in adit 11 ft above, overlain by 2 ft shear zone of oxide ore
60
20' deep
ore
chert
25
INCLINED SHAFT
40
D
U
fault in back
fault "A"
35
70
all gouge below fault "A"
40 fault "A"
60
60
40-60
gouge
chert
chert
80
80
55
chert
30
80
sandstone gouge
LOWER WORKINGS
UNDERGROUND WORKINGS
0 50 100 FT
SCALE


N
Js
Juc
Jc
Jrc
2200
2100
2000
1900
1800
1700
1600
NORTH ORE BED
SOUTH ORE BED
MAIN ADIT
EAST ADIT
ORE BIN
TRAIL
A
A'
D.D.H. No 1 (DIP 33°)
D.D.H. No 2 (DIP 55°)
D.D.H. No 3 (DIP 3°)
D.D.H. No 4 (DIP 3°)
NW A
SE A'
2,100'
2,000'
1,900'
1,800'
D.D.H. No 2
Manganese ore zone
Upper level 1925'
Lower level 1890'
Section along line A-A'
EXPLANATION
Franciscon group
JURASSIC(?)
Js
Predominantly sandstone with some shale
Jrc
Red chert
Jc
White and green chert
Juc
Undifferentiated red and white chert
Manganese ore
Manganiferous outcrop
North ore bed, upper level workings
North ore bed, lower level workings
Inferred position of north ore bed at upper level
Inferred position of north ore bed at lower level
Approximate stratigraphic horizon in chert
Fault
30
Strike and dip of beds
Strike and dip of vertical beds
70
Strike and dip of overturned beds
Axis of syncline
Adit
Collar of diamond-drill hole (D.D.H.)
Mine dump
100
0
100
500 FEET
Contour interval 25 feet
Datum is mean sea level

REPRINTED FROM U S GEOLOGICAL SURVEY
PRELIMINARY MAP

GEOLOGIC AND TOPOGRAPHIC MAP OF THE BUCKEYE MINE AREA STANISLAUS COUNTY CALIFORNIA

GEOLOGY AND TOPOGRAPHY BY W G PIERCE
1941
DIAMOND DRILLING BY BUREAU OF MINES

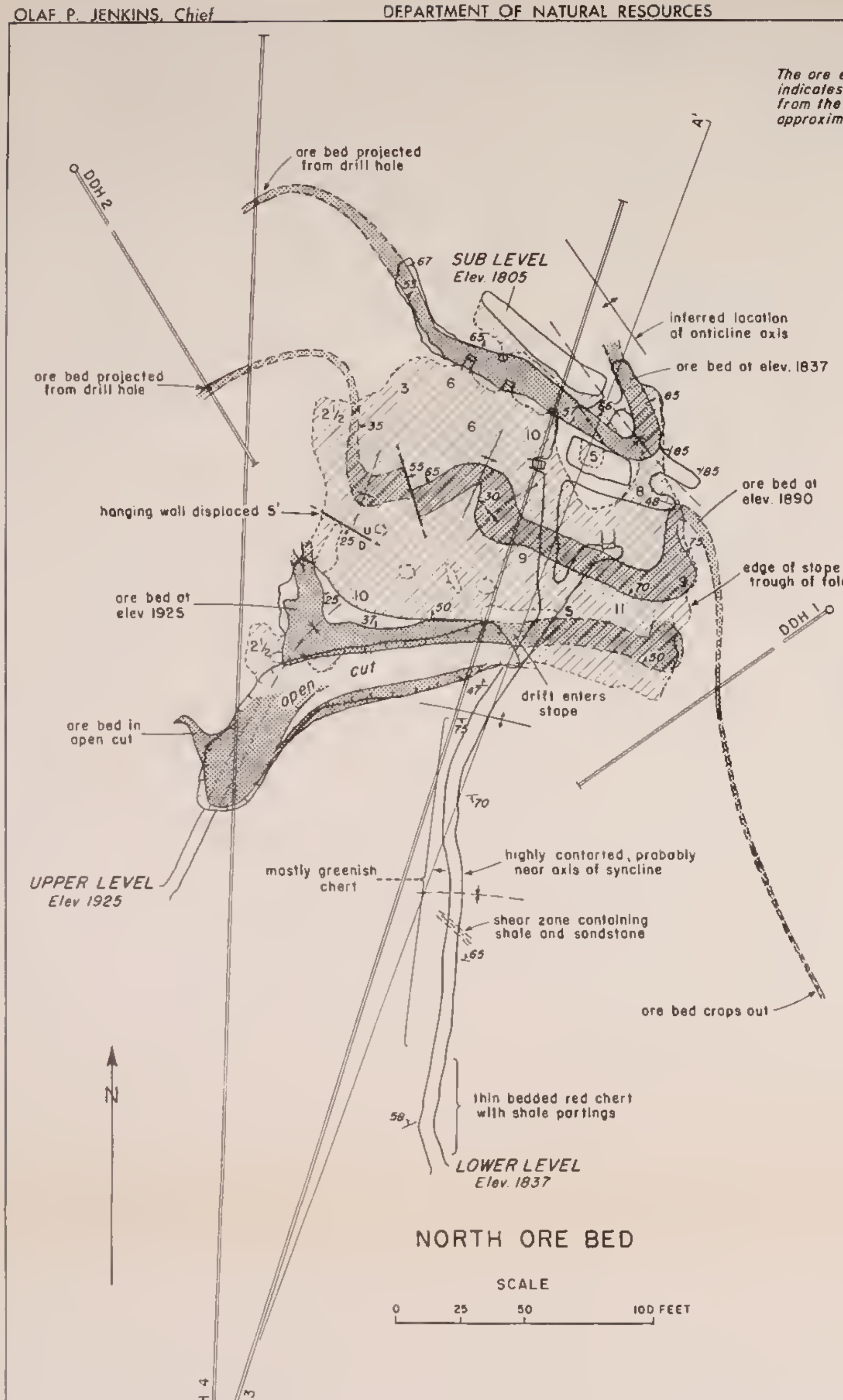
DIVISION OF MINES
OLAF P. JENKINS, *Chief*

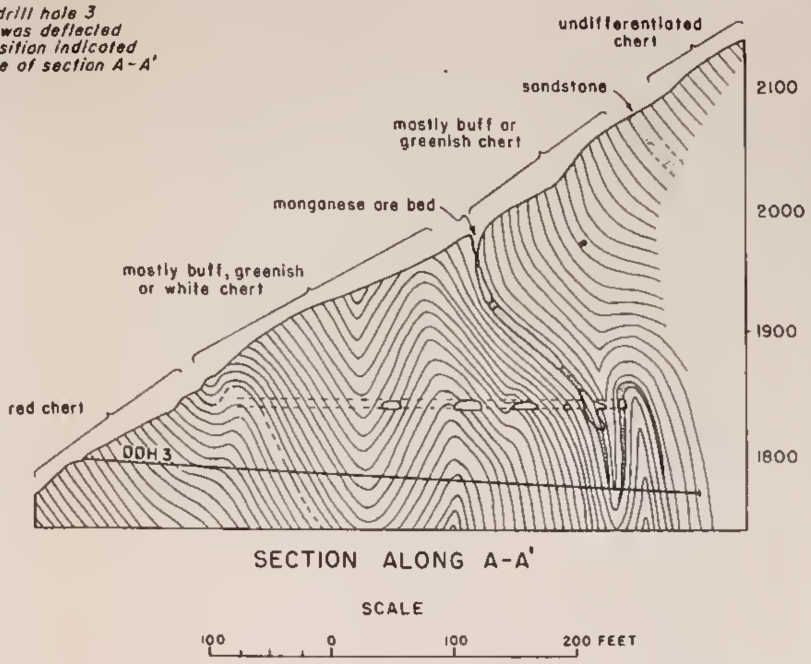
STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BULLETIN 152
PLATE 18

The ore encountered in drill hole 3 indicates that the hole was deflected from the theoretical position indicated approximately to the line of section A-A'


ore bed projected from drill hole
DDH 2
SUB LEVEL
Elev. 1805
inferred location of anticline axis
ore bed at elev. 1837
ore bed projected from drill hole
hanging wall displaced 5'
ore bed at elev. 1890
edge of stope follows trough of fold
ore bed at elev 1925
DDH 1
open cut
drift enters stope
ore bed in open cut
UPPER LEVEL
Elev 1925
mostly greenish chert
highly contorted, probably near axis of syncline
shear zone containing shale and sandstone
ore bed crops out
thin bedded red chert with shale partings
LOWER LEVEL
Elev. 1837
A'
DDH 4
DDH 3
N
2½
3
6
6
10
5
8
9
10
5
11
2½
3
67
53
65
51
56
65
85
85
48
35
55
65
30
25
75
70
50
25
37
50
47
75
70
65
58
U
D
NORTH ORE BED
SCALE
0
25
50
100 FEET


undifferentiated chert
sandstone
mostly buff or greenish chert
manganese ore bed
mostly buff, greenish or white chert
red chert
DDH 3
2100
2000
1900
1800
SECTION ALONG A-A'
SCALE
100
0
100
200 FEET

Manganese ore of North Ore Body: Mostly black oxides above Elev 1900, mostly primary rhodochrosite, hausmannite and manganese silicates below 1900 level

EXPLANATION

▨ Manganese ore

▨ Stope

Open cut

Fault showing dip

Axis of anticline

Axis of syncline

Strike and dip of beds or walls

Shear zone

9 Feet between footwall and hanging wall of stope

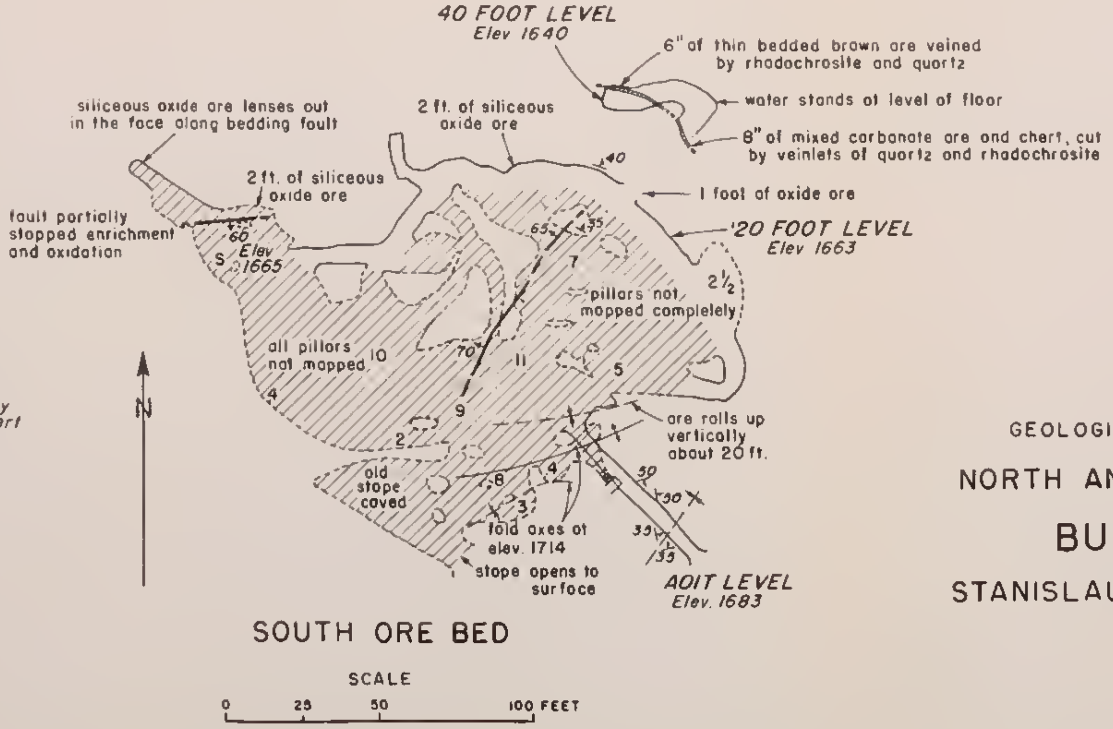
⊠ Top of raise or winze

⊠ Bottom of raise or winze

Ore chute

DDH 3 U.S. Bureau of Mines Diamond drill hole

GEOLOGY BY MAX D. CRITTENDEN, JR., 1944;
S. G. LASKY CHARLES R. WARREN AND FRANK
S. SIMONS, 1940-41


40 FOOT LEVEL
Elev 1640
6" of thin bedded brown ore veined by rhodochrosite and quartz
water stands at level of floor
8" of mixed carbonate ore and chert, cut by veinlets of quartz and rhodochrosite
siliceous oxide ore lenses out in the face along bedding fault
2 ft. of siliceous oxide ore
2 ft. of siliceous oxide ore
1 foot of oxide ore
fault partially stopped enrichment and oxidation
Elev 1665
20 FOOT LEVEL
Elev 1663
pillars not mapped completely
all pillars not mapped
ore rolls up vertically about 20 ft.
old stope caved
fold axes at elev. 1714
stope opens to surface
ADIT LEVEL
Elev. 1683
N
40
65
35
60
70
30
35
35
30
7
2½
10
11
5
4
9
2
8
4
3
S
SOUTH ORE BED
SCALE
0
25
50
100 FEET

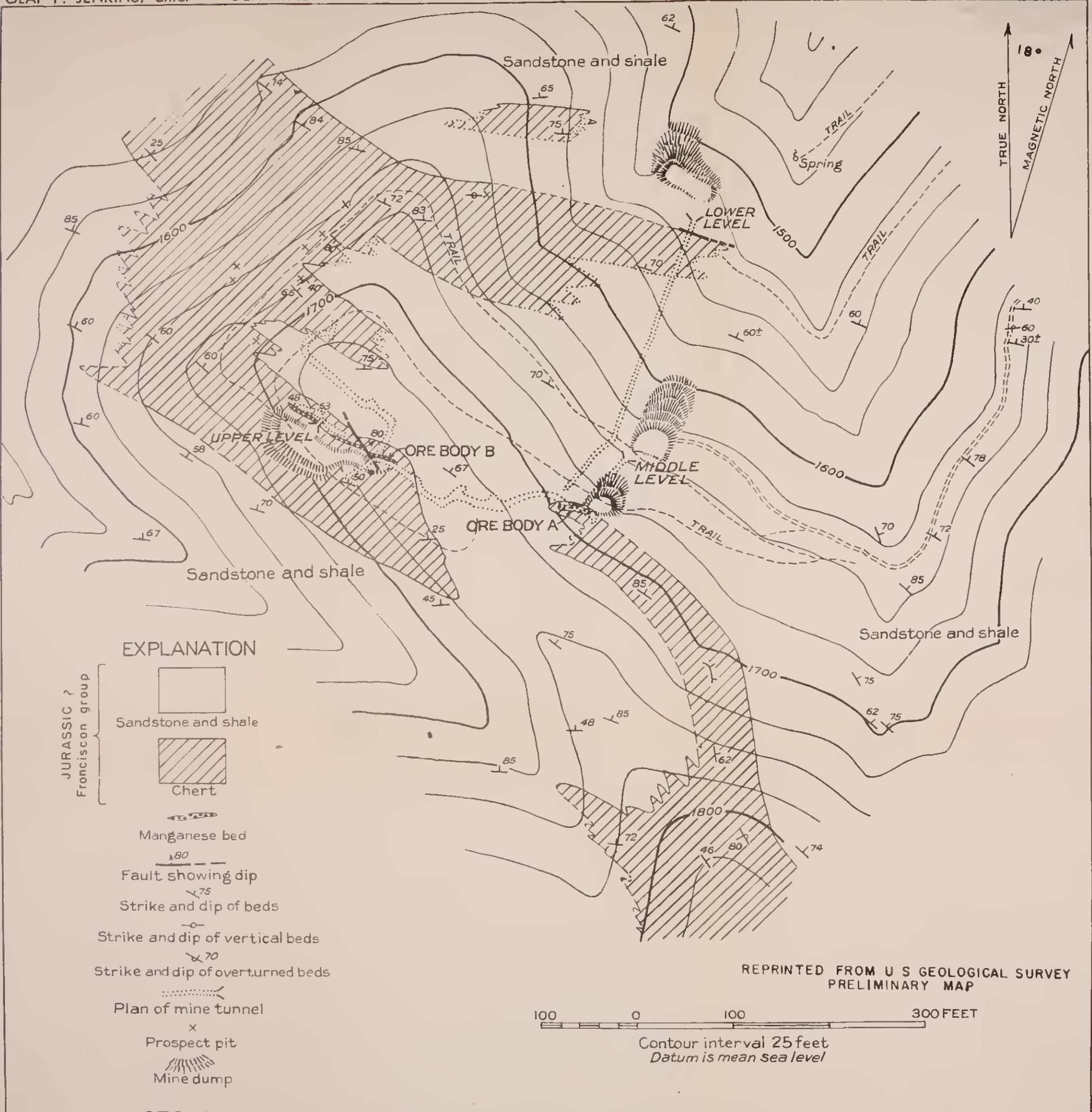
Workings of South Ore Bed yielded about 3800 long tons of oxide ore averaging 48% manganese. Primary ore is low grade manganiferous chert and rhodochrosite. Wall rocks are buff or white chert throughout

GEOLOGIC MAPS AND SECTION

NORTH AND SOUTH ORE BEDS

BUCKEYE MINE

STANISLAUS COUNTY, CALIFORNIA


TRUE NORTH
MAGNETIC NORTH
18°
Sandstone and shale
Sandstone and shale
Sandstone and shale
Spring
TRAIL
TRAIL
TRAIL
TRAIL
LOWER LEVEL
MIDDLE LEVEL
UPPER LEVEL
ORE BODY A
ORE BODY B
1500
1600
1600
1700
1700
1800
EXPLANATION
JURASSIC ?
Franciscan group
Sandstone and shale
Chert
Manganese bed
Fault showing dip
Strike and dip of beds
Strike and dip of vertical beds
Strike and dip of overturned beds
Plan of mine tunnel
Prospect pit
Mine dump
100
0
100
300 FEET

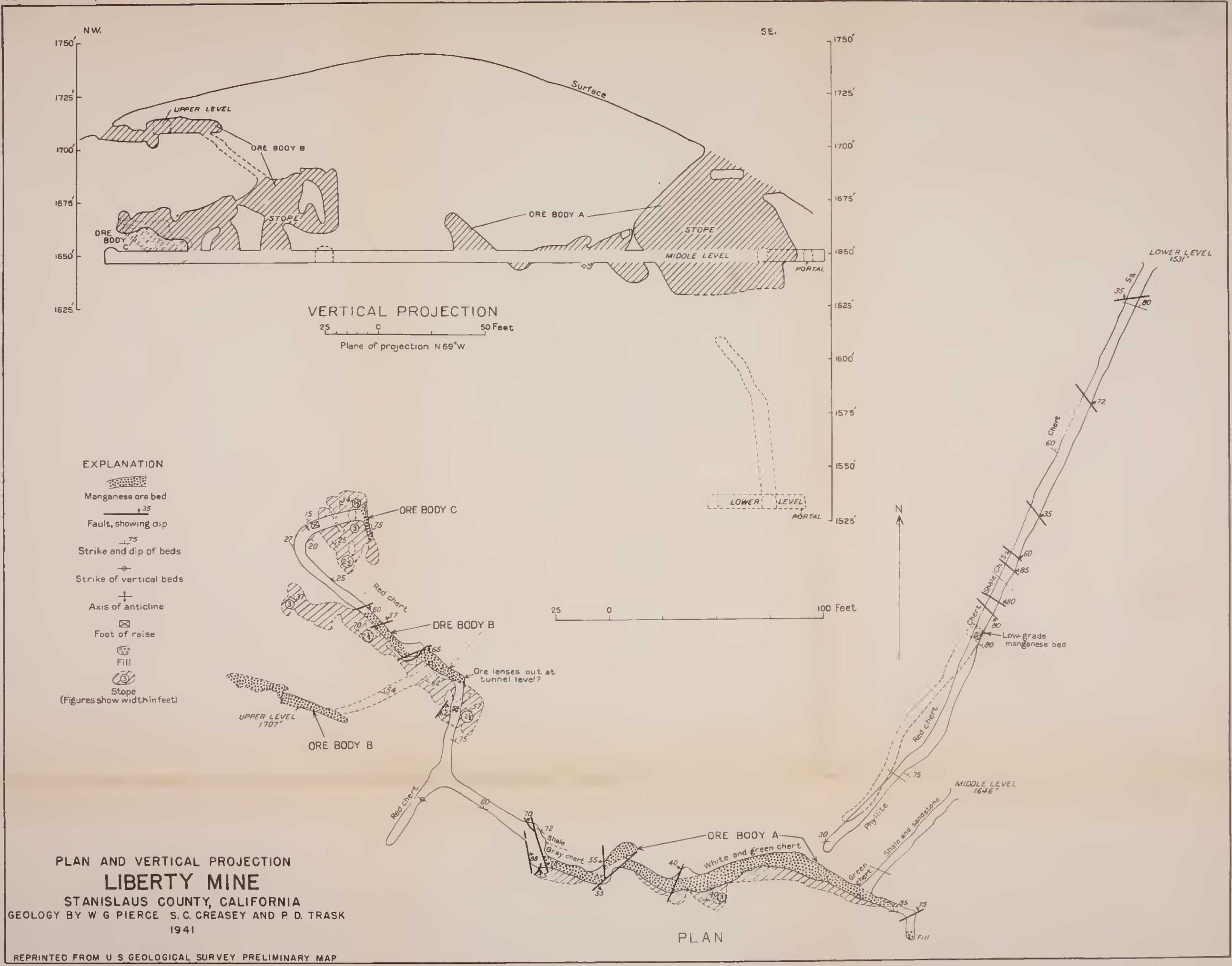
REPRINTED FROM U S GEOLOGICAL SURVEY PRELIMINARY MAP

Contour interval 25 feet
Datum is mean sea level

GEOLOGIC AND TOPOGRAPHIC MAP OF THE LIBERTY MINE AREA STANISLAUS COUNTY, CALIFORNIA

GEOLOGY AND TOPOGRAPHY BY W. G. PIERCE

1941

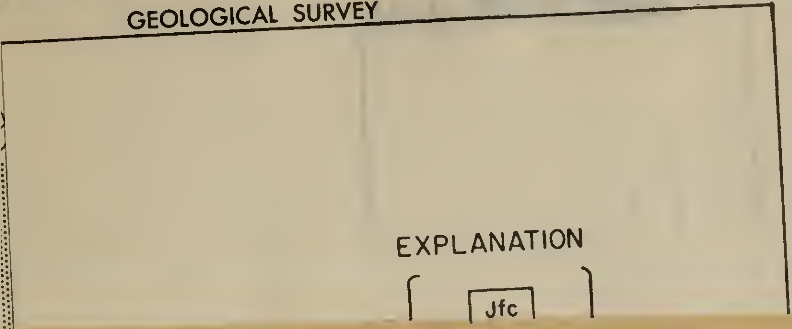

NW.
SE.
1750′
1725′
1700′
1675′
1650′
1625′
1600′
1575′
1550′
1525′
Surface
UPPER LEVEL
ORE BODY B
STOPE
ORE BODY A
STOPE
ORE BODY C
MIDDLE LEVEL
PORTAL
LOWER LEVEL
PORTAL
VERTICAL PROJECTION
25 0 50 Feet
Plane of projection N 69° W
EXPLANATION
Manganese ore bed
Fault, showing dip
Strike and dip of beds
Strike of vertical beds
Axis of anticline
Foot of raise
Fill
Stope (Figures show width in feet)
ORE BODY C
Red chert
ORE BODY B
Ore lenses out at tunnel level?
UPPER LEVEL 1707′
ORE BODY B
Red chert
Shale
Gray chert
ORE BODY A
White and green chert
Green chert
Shale and sandstone
Phyllite
Red chert
Chert
Shale (Ch. SS.)
Low-grade manganese bed
LOWER LEVEL 1531′
MIDDLE LEVEL 1646′
Fill
25 0 100 Feet
N
PLAN

PLAN AND VERTICAL PROJECTION
LIBERTY MINE
STANISLAUS COUNTY, CALIFORNIA
GEOLOGY BY W G PIERCE S. C. CREASEY AND P. D. TRASK
1941

REPRINTED FROM U S GEOLOGICAL SURVEY PRELIMINARY MAP

ITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BULLETIN 152
PLATE 1


EXPLANATION
Jfc